

ACTA SOCIETATIS ZOOLOGICAE BOHEMICAЕ

Vol. 61

No. 4

1997

ISSN 0862-5247

ACTA SOCIETATIS ZOOLOGICAE BOHEMICAE¹⁾

Acta Soc. Zool. Bohem. Vol. 61, No. 4

issued 1997 December 29

ISSN 0862-5247

47678

Editor: Karel Hürka
Executive editor: David Král

Editorial board: Petr Benda, Jan Buchar, Ivó Hodek, Alois Honěk, Jaroslav Hrbáček, Vojtěch Jarošík, František Moravec, Josef Rusek, Jiří Vávra, Zdeněk Veselovský, Jan Zima

Published and distributed by the Czech Zoological Society. Orders should be sent to the Czech Zoological Society, Viničná 7, CZ-128 00 Praha 2, Czech Republic. Print by the Čihák tisk, Štěrboholská 21, CZ-102 00 Praha 10, Czech Republic.

Annual subscription (Volume 61, 1997, 4 issues)

Institutional subscription:	Europe:	USD 80.00
	Other countries:	USD 90.00
Private subscription:	Europe:	USD 40.00
	Other countries:	USD 50.00

This issue was supported by the Ministry of Education (MŠMT ČR).

© Czech Zoological Society, Praha, 1997

¹⁾ A direct continuation of:

- (i) Vol. 1 (1927-1932): Zpráva o činnosti československé zoologické společnosti za léta 1927-1932
- (ii) Vol. 2-53 (1933-1989): Věstník československé společnosti zoologické (*Věst. Čs. Společ. Zool.*)
- (iii) Vol. 54-56 (1990-1992): Acta Societatis Zoologicae Bohemoslovacae (*Acta Soc. Zool. Bohemoslov.*)

**This issue is dedicated
to Professor Jan Buchar
on occasion of his 65th birthday
and
to the late Professor František Miller
on occasion of his 95th birthday**

Professor Jan Buchar – a tribute to his 65th birthday

Born 18 February, 1932 in Bystrá nad Jizerou, Jan Buchar studied secondary grammar school in Jilemnice and, an enthusiastic bird-watcher, began studies at the Faculty of Natural Sciences, Charles University in Prague. He graduated in 1956 by defending his thesis in hydrobiology. As an undergraduate student, he acted as an assistant lecturer at the Faculty during the last two years of his study. After graduation, he joined the Faculty as an assistant professor, where he defended his habilitation thesis to become reader ("docent") in zoology. In 1994, Dr Buchar was appointed to Professor of Zoology. He was Head of the Department of Zoology from 1986 to 1990 and Head of the Sub-Department of the Zoology of Invertebrates from 1990 to 1995.

Professor Buchar is highly committed to his teaching activities. He lectures on the system, phylogenesis, and comparative morphology of invertebrates, biogeography, arachnology and protection of invertebrates, and the use of invertebrates for bioindication purposes. He also acts as a trainer in field and laboratory exercises and practice on the zoology of invertebrates. As a university teacher, Professor Buchar supervised over thirty diploma works and theses. He also organized several student expeditions to the Caucasus and Central Asia.



After his initial interest in the taxonomy and ecology of protozoans, Jan Buchar ultimately turned his attention to arachnology in 1958. Since then, he has been involved in the taxonomic and zoogeographic study of palearctic wolf spiders of the family Lycosidae, and in a complex study of the arachnofauna of the Czech Republic aimed at the exploitation of faunistic data for the monitoring of environmental changes in this country.

During his study visits, Professor Buchar worked at arachnological institutes and departments in Austria, Poland, Russia, and Bulgaria, and collected material in various regions of Siberia, Central Asia, the Caucasus, the Crimea, Hungary and Crete. His studies of the family Lycosidae contributed to our knowledge of the arachnofauna of Italy, Romania, Bulgaria, the Caucasus, Nepal, Afghanistan, and Austria. His many year's collaboration with Docent Konrad Thaler of the Innsbruck University brought fruits in the form of eight joint publications.

Professor Buchar started his study of the arachnofauna of the Czech Republic by examining 21 model sites representative of major original ecosystems of Bohemia. The scopes of diploma works he defined were all well targeted. Professor Buchar was involved in the publication of the grid map of Czechoslovakia by the Zoological Society, and organized grid mapping of the occurrence of the spider family Lycosidae.

Professor Buchar's work is summarized in two crucial theses, in which he presented a comprehensive evaluation of the arachnofauna of Bohemia, revised all older data, put forth a biogeographic

categorization of spider termpreference, and developed a classification of spider species with respect to their ability to inhabit sites disturbed by man to various degrees. The outcome of this work was published in several articles (Buchar 1975, 1983a, 1992c, Buchar et al. 1995).

To date, Professor Buchar has produced about seventy publications in arachnology and dozens of other publications, including popularizing articles devoted to various problems in zoology, the history of science, and protection of nature. He presented lectures at five International Congresses of Arachnology, at numerous other scientific conferences, and was engaged in the preparation of the Czechoslovak-Polish Symposium of Arachnology in Ostrava and organization of the 15th European Colloquium of Arachnology in České Budějovice.

Professor Buchar also authored several university textbooks on the zoology of invertebrates and a book about zoogeography (Buchar J. 1983: *Zoogeografie*. SPN, Praha). He also contributed chapters often very extensive on the evolution, taxonomy and zoogeography of invertebrates in many other textbooks on zoology, general biology and historical evolution of organisms, a book dealing with the Krkonoše (Giant Mountains) National Park, a representative encyclopedia dedicated to

- BUCHAR J. 1969: Pavoukovci (Arachnoidea) [Spiders (Arachnoidea)]. : Pp.: 11–31. In.: BOHÁČ D. (ed.): *Zvířena jižních Čech [Fauna of South Bohemia]*. Č. Budějovice: Kraj. pedagog. nakl. (in Czech.), 147 pp.
- BUCHAR J. 1969: Die langfristige Durchforschung der Spinnenfauna Böhmens und ihre vorläufige Ergebnisse. *Stud. Geogr. Brno*: 129–135, 158 (in Czech, Germ. abstr.).
- BUCHAR J. 1969: Witt P. N., Reed Ch. F. & Peakall D. B. 1968: *A Spider's Web*. Springer Verlag Berlin-Heidelberg-New York, 107 pp. *Čs. Fysiologie* 18: 468 (book review).
- BUCHAR J. 1970: Beiträge zur Arachnofauna von Böhmen II (Elbetal). *Bohemia Centr.* 2: 43–58 (in Czech, Germ. abstr.).
- BUCHAR J. 1970: Dynamique des populations d'Araignées. *Bull. Mus. Natl. Hist. Natur.* 2 sér. 41: 217–225.
- BUCHAR J. 1970: Zoolog a cestovatel dr. Jiří Baum [Zoologist and traveller dr. Jiří Baum]. *Vesmír* 49(12): 372 (in Czech.).
- BUCHAR J. 1971: Die Verwandtschaftsbeziehungen der Art *Pardosa cincta* (Kulcz.) (Araneae, Lycosidae). *Acta Univ. Carol. – Biol.* 1970: 121–129.
- BUCHAR J. 1971: Zur Struktur der Arachnofauna des Böhmengebietes. P.: 7. In: *Proc. Vth Int. Congr. of Arachnology*. Brno: Institute of Vertebrate Zoology.
- BUCHAR J. 1971: Co předcházelo letošnímu mezinárodnímu kongresu arachnologů v Brně [What did precede before the International Congress in Brno]. *Živa* 19: 142–143 (in Czech).
- BUCHAR J. 1972: *Rozbor pavoučí zvířeny Čech [An analysis of Bohemian fauna of spiders]*. Habil. Dissertation, Faculty of Natural History, Charles University, Praha, I (pp. 1–1266), II (pp. 267–394) (in Czech).
- BUCHAR J. 1972: Mohou být pavouci včelám nebezpeční [May be the spiders dangerous for the honey-bee]? *Včelařský Magazin* 6: 56–59 (in Czech).
- BUCHAR J. 1972: Letci bez křídel [The flyers without wings]. *Živa* 20: 182–183 (in Czech).
- MILLER F. & BUCHAR J. 1972: Einige neue Spinnenarten (Araneae) aus dem Hindukusch. *Acta Univ. Carol. – Biol.* 1970: 383–398.
- BUCHAR J. 1973: V. mezinárodní arachnologický kongres v Brně [5th International Congress of Arachnology in Brno]. *Vertebrat. Zpr.* 1973: 55–56 (in Czech).
- BUCHAR J. 1974: Malá historie pavoučích států [A small history of the spider states]. *Živa* 22: 26–29 (in Czech).
- BUCHAR J. & POLENEC A. 1974: Zur Lycosidenfauna Jugoslawiens (Araneae: Lycosidae). *Věst. Čs. Společ. Zool.* 38: 81–85.
- BUCHAR J. & ŽITNANSKÁ O. 1974: Uplatňování ekologického přístupu v československém arachnologickém výzkumu [An appliance of ecological methods in Czechoslovakian arachnological research]. *Zpr. Čs. Zool. Společ.* 4–6: 49–53 (in Czech).
- BAUM J. & BUCHAR J. 1974: *V říši pavouků [In the realm of spiders]*. Praha: SPN, 289 pp (in Czech).
- BUCHAR J. 1975: Arachnofauna Böhmens und ihr thermophiler Bestandteil. *Věst. Čs. Společ. Zool.* 39: 241–250.
- BUCHAR J. 1975: Methods of the faunistic research in Arachnology. *Z Minulosti a Přítomnosti Turca (Martin)* 3: 95–106 (in Czech, Engl. abstr.).
- BUCHAR J. 1976: Über einige Lycosiden (Araneae) aus Nepal. *Khumbu Himal, Innsbruck-München* 5: 201–227.
- BUCHAR J. 1976: K pavoučí zvířence SPR Kopeč [Spiders of State nature reserve Kopeč]. *Bohemia Centr.* 5: 161–165 (in Czech).
- BUCHAR J. 1977: Pavouci – Araneida [Spiders – Araneida]. Pp.: 443–467. In.: ROČEK Z. (ed.): *Příroda Orlických hor a Podorlicka [Nature of Orlické hory Mts. and Foothills]*. Praha: SZN, 660 pp. (in Czech).
- MILLER F. & BUCHAR J. 1977: Neue Spinnenarten aus der Gattung *Zelotes* Distel und *Haplodrassus* Chamberlin (Araneae, Gnaphosidae). *Acta Univ. Carol. – Biol.* 1974: 157–171.
- BUCHAR J. 1977: Lycosiden aus dem Nepal-Himalaya. I. Die Gattung *Acantholycosa* Dahl 1908 und die *Pardosa sutherlandi*-Gruppe (Araneae: Lycosidae: Pardosinae). *Senckenbergiana Biol.* 59: 253–265.
- BUCHAR J. 1977: Dostaveníčko s pavouky [A meeting with spiders]. *Živa* 25: 23–25 (in Czech).
- BUCHAR J. 1978: Structure and Changes in the Bohemian Spider Fauna. *Symp. Zool. Soc. Lond.* 42: 505.
- BUCHAR J., ANTUŠ M., HAJER J., POTUŽÁKOVÁ H. & ŠTEIGEROVÁ A. 1979: Arachnofauna aus dem Tale Brná nad Labem. *Fauna Bohem. Septentr.* 4: 77–92 (in Czech, Germ. abstr.).
- BUCHAR J. 1979: Martens, J. 1978: Weberknechte. Opiliones. Die Tierwelt Deutschlands, 64. Teil, VEB G. Fischer Verlag, Jena. 464 pp. *Věst. Čs. Společ. Zool.* 43: 82 (book review).
- BUCHAR J. 1980: Lycosidae aus dem Nepal-Himalaya. II. Die *Pardosa nebulosa*- und *P. venatrix*-Gruppe (Araneae: Lycosidae: Pardosinae). *Senckenbergiana Biol.* 61: 77–91.
- BUCHAR J. 1981: Zur Lycosiden-Fauna von Tirol (Araneae, Lycosidae). *Věst. Čs. Společ. Zool.* 45: 4–13.
- BUCHAR J. 1981: Die Spinnen der Třeboň-Umgebung aus der Sammlung von Gymnasial-Professor J. Martinck. *Sbor. Jihočes. Muz., Čes. Budějovicích, Přír. Vědy* 21: 1–12 (in Czech, Germ. abstr.).
- BUCHAR J. 1982: Proč výbor československé zoologické společnosti při ČSAV vydal mapu ČSSR pro záznam výskytu organismů? [Why did the council of The Czechoslovak zoological society edited the map of ČSSR for the recording of the occurrence of organisms?] *Živa* 30: 182–184 (in Czech).
- BUCHAR J. 1982: K vývoji naší arachnologie [On the development of the Czechoslovak arachnology]. *Věda v Československu 1945–1960* 2: 199–206 (in Czech).

- BUCHAR J. 1982: *Interní pomůcka katedry systematické zoologie pro spolupracovníky na výzkumném úkolu „Sítového mapování čeledi Lycosidae“* [The internal help for collaborators on quadrat mapping of Lycosidae]. Unpubl., Department of Zoology, Charles University, Praha, 7 pp. (in Czech).
- BUCHAR J. 1982: Publication of faunistic data from Czechoslovakia. *Věst. Čs. Společ. Zool.* **46**: 317–318 (in Czech, Engl. abstr.).
- BUCHAR J. 1983: Die Klassifikation der Spinnenarten Böhmens als ein Hilfsmittel für die Bioindikation der Umwelt. *Fauna Bohemiae Septentr.* **8**: 119–135 (in Czech, Germ. abstr.).
- BUCHAR J. 1983: Problematika ochrany pavoukoveň se zvláštním zřetelem ke změnám rozšíření některých druhů pavouků [Problematics of protection of arachnoids, with special reference to changes of distribution some spider species]. Pp.: 60–66. In: *Proc. Conf. Aktuální problémy ochrany fauny v ČSSR*. Brno.
- BUCHAR J. 1983: Results of the Faunistic Investigation of the Krkonoše (Giant Mountains)(I). *Opera Corcontica* **20**: 99–114.
- BUCHAR J., LAŠTOVKOVÁ E. & MACHÁČEK O. 1983: The influence of chemical impact against *Steganoptycha diniana* on soil surface dwelling arthropods. In: SKUHRAVÝ V. (ed.): Hmyzí škůdci lesních porostů v Krkonoších [Insect pests of forests in the Giant Mts.]. *Opera Corcontica* **20**: 130 (in Czech, Engl. abstr.).
- BUCHAR J. 1983: Bioindikační využití pavouků [Employment of spiders for bioindication]. *Nika* **4**(3): 11–14 (in Czech).
- BUCHAR J. & THALER K. 1984: Eine zweite Diaca-Art in Mitteleuropa (Araneida, Thomisidae). *Věst. Čs. Spol. Zool.* **48**: 1–8.
- BUCHAR J. 1984: Za profesorem RNDr. Františkem Millerem, DrSc. [In memory of Prof. RNDr. František Miller, DrSc.]. *Živa* **32**: 60 (in Czech).
- BUCHAR J. 1984: Význam pavouků obývajících polní kultury [Importance of the spiders occurring the agroecosis]. *Živa* **32**: 140 (in Czech).
- BUCHAR J. 1984: Lycosidae aus dem Nepal-Himalaya. III. Die *Pardosa ricta*- und *P. lapponica*-Gruppe. (Araneae: Lycosidae: Pardosinae). *Senckenbergiana Biol.* **64**: 381–391.
- BUCHAR J. 1985: Poznámky k výskytu stepníka rudého na Úhošti a k významu podobných teplomilných druhů mediteránního původu vůbec [Notes to the occurrence of *Eresus cinnaberinus* in the locality Úhošť]. *Živa* **33**: 104–105 (in Czech).
- BUCHAR J. 1985: In memory of MUDr. Vladimír Šilhavý, CSc. *Acta Entomol. Bohemoslov.* **82**: 157–158.
- DUNIN P. M., BUCHAR J. & ABSOLON K. 1986: Die dritte paläarktische *Aulonia*-Art: *Aulonia kratochvili* sp. n. (Araneida, Lycosidae). *Věst. Čs. Společ. Zool.* **50**: 28–32.
- BUCHAR J. 1986: Distribution and changes in the distribution of the wolf spiders in the west of Czechoslovakia. P.: 414. In: BARRIENTOS J. A. (ed.): *Actas X Congr. Int. Aracnol., Jaca/España*.
- BUCHAR J. 1987: First Czechoslovak-Polish Arachnological Symposium: "Long and short time changes in spider fauna". *Arachnologia, C. I. D. A, Paris* **4**: 5.
- BUCHAR J. 1987: Několik poznámek k historii československé arachnologie se zvláštním zaměřením na území Čech [Several notes to history of Czechoslovakian arachnology with the particular view to the Bohemian territory]. *Zpravodaj Ochrany Přírody Města Ostravy* **1987**: 5–10 (in Czech).
- BUCHAR J. 1987: Předpoklady pro využití arachnofauny ke sledování přírodních poměrů [Die Voraussetzungen für die Auswertung der Erforschung der Arachnofauna für das Studium der Entwicklung der Naturverhältnisse]. *Zpravodaj Ochrany Přírody Města Ostravy* **1987**: 37–44 (in Czech).
- BUCHAR J. 1988: Arachnological section of the Slovakian entomological society of Slovakian academy of Sciences. *Amer. Arachnol.* **38**: 11.
- BUCHAR J. 1988: Die Voraussetzungen für die Auswertung der Erforschung der Arachnofauna für das Studium der Entwicklung der Naturverhältnisse. *Acta Fac. Paed. Ostraviensis* **112**, ser. E-18: 170.
- BUCHAR J. 1988: Eine quantitative Schätzung der Arachnofauna Böhmens. In: HAUPT J. (ed.): XI. Europäisches Arachnologisches Colloquium. *Dokumentation Kongresse und Tagungen* **38**: 132.
- BUCHAR J. 1989: Eightieth birthday of Academician Josef Kratochvíl. *Acta Entomol. Bohemoslov.* **86**: 476.
- BUCHAR J., BABRAKZAI H. & HODEK I. 1989: Life cycle and phenology of the spider *Pisaura mirabilis* (Araneae) in central Europe. *Acta Entomol. Bohemoslov.* **86**: 414–418.
- BUCHAR J. 1989: Akademik J. Kratochvíl arachno-entomolog [Academician J. Kratochvíl arachno-entomologist]. *Zpr. ÚSEB Brno* **1989**: 51–52 (in Czech).
- BUCHAR J. 1989: *Poznání současné arachnofauny Čech a jeho využití k posouzení vývoje přírodních poměrů* [The knowledge of the present Bohemian arachnofauna and its improvement to evaluation of natural conditions]. DrSc. Dissertation, Faculty of Natural history, Charles University, Praha. 172 pp. (in Czech).
- BUCHAR J. & HAJER J. 1990: Zur Arachnofauna des Bezirks Ústí nad Labem. *Sbor. Pedag. Fak. Ústí n. L., Biol.* **1990**: 25–53 (in Czech, Germ. abstr.).
- BUCHAR J. 1991: Využití faunistických dat pro biomonitoring [Employment of faunistic data for biomonitoring]. P.: 25. In: *Abstrakta referátů VIII. sjezdu čs. zoologů*. Brno (in Czech).

- BUCHAR J. 1992: Pavoukovci Arachnida. Pp.: 39–53. In: ŠKAPEC L. (ed.): *Červená kniha ohrožených a vzácných druhů rostlin a živočichů ČSFR 3* [Red Book of endangered and rare species living in the territory of the Czechoslovak Federal Republic 3]. Bratislava: Príroda, 155 pp. (in Czech).
- BUCHAR J. 1992: Contribution to knowledges of spider fauna in the Protected landscape area Železné hory Mts. Pp.: 28–34. In: *Sborník referátů z konference uspořádané u příležitosti 1. výročí vyhlášení CHKO Železné hory*. Nasavrky: Správa CHKO Železné hory (in Czech, Engl. abstr.).
- THALER K. & BUCHAR J. 1993: Eine verkannte Art der Gattung Lophyphantes in Zentraleuropa: *L. tripartitus* Miller & Svatoň (Araneida: Linyphiidae). *Mitt. Schweiz. Entomol. Gesell.* **66**: 149–158.
- BUCHAR J. 1992: Kommentierte Artenliste der Spinnen Böhmens (Araneida). *Acta Univ. Carol. – Biol.* **36**: 383–428.
- BUCHAR J. & THALER K. 1993: Die Arten der Gattung Acantholycosa in Westeuropa (Arachnida, Araneida: Lycosidae). *Rev. Suisse Zool.* **100**: 327–341.
- BUCHAR J. 1993: The use of faunistic data for biomonitoring. *Bull. Soc. Neuchâtel. Sci. Nat.* **116**: 49–57.
- BUCHAR J. & KOROLEVA J. 1994: The mapping for bioindication and nature conservation purposes. *Věst. Mosk. Univ. Ser. 5, Geogr.* **6**: 44–51.
- BUCHAR J. 1993: Biogeographical and ecological relations of wolf spiders in Czechoslovakia and in Central Europe. *Boll. Acc. Gioenia Sci. Natur. Catania* **26**: 27–34.
- THALER K. & BUCHAR J. 1994: Die Wolfspinnen von Österreich 1: Gattungen Acantholycosa, Alopecosa, Lycosa (Arachnida, Araneida: Lycosidae) – Faunistisch-tiergeographische Übersicht. *Carinthia II, Klagenfurt* **184/104**: 357–375.
- KASAL P., CHVÁTALOVÁ I., BUCHAR J. & ZBYTEK F. 1994: Ecological types of linyphiid spiders. P.: 54. In: *Abstracts of 15th Europ. Coll. Arachnol.* České Budějovice: Inst. of Entomology.
- BUCHAR J. 1995: Bohemian wolf spiders (Araneida: Lycosidae). *Acta Univ. Carol. – Biol.* **39**: 3–28.
- BUCHAR J. 1995: Zoogeographical questions of Czech spiders. P.: 210. In: RŮŽIČKA V. (ed.): *Proc. 15th Europ. Coll. Arachnol.* České Budějovice: Inst. of Entomology.
- BUCHAR J. 1995: Jak je utvářeno tělo pavouka [How is built a spider body]. *Živa* **43**: 185–187 (in Czech).
- BUCHAR J., RŮŽIČKA V. & KŮRKA A. 1995: Check list of spiders of the Czech Republic. Pp.: 35–53. In: RŮŽIČKA V. (ed.): *Proc. 15th Europ. Coll. Arachnol.* České Budějovice: Inst. of Entomology.
- BUCHAR J. & THALER K. 1995: Die Wolfspinnen von Österreich 2: Gattungen Arctosa, Tricra, Trochosa (Arachnida, Araneida: Lycosidae) – Faunistisch-tiergeographische Übersicht. *Carinthia II, Klagenfurt* **185/105**: 481–498.
- COKENDOLPHER J. C. & BUCHAR J. 1995: Additions and corrections to MUDr. Vladimír Silhavy's bibliography. *Arachnologia, C. I. D. A., Paris* **12**: 5–6.
- BUCHAR J. 1995: Two remarkable relict spider communities in Czech Republic. P.: 6. In: *Abstracts XIIIth Int. Congr. Arachnology*. Ville de Genève: Muséum d'histoire naturelle.
- BUCHAR J. & THALER K. 1995: Zur Variation der Kopulationsorgane von *Pistius truncatus* (Pallas) (Araneida, Thomisidae) in Mitteleuropa. *Linzer Biol. Beitr.* **27**: 653–663.
- RŮŽIČKA V., BUCHAR J., KASAL P. & CHVÁTALOVÁ I. 1996: Pavouci národního parku Podyjí [The Spiders of the Podyjí National Park]. *Fauna Bohem. Septentr.* **21**: 99–115 (in Czech, Engl. abstr.).
- BUCHAR J. 1996: Zoogeografické otázky rozšíření čeledi Lycosidae v bývalé ČSFR [Zoogeographical distribution of family Lycosidae in former Czechoslovakia]. *Entomofauna Carpathica, Bratislava* **8**: 52–55 (in Czech).
- THALER K. & BUCHAR J. 1996: Die Wolfspinnen von Österreich 3: Gattungen Aulonia, Pardosa (p. p.), Pirata, Xerolycosa (Arachnida, Araneida: Lycosidae) – Faunistisch-tiergeographische Übersicht. *Carinthia II, Klagenfurt* **186/106**: 393–410.
- MILLER F. & BUCHAR J. 1997: Spiders (Chelicerata: Araneae) collected in small mammal nests in the Western Carpathians. *Acta Soc. Zool. Bohem.* **61**: 373–379.
- THALER K., BUCHAR J. & KŮRKA A. 1997: A new species of Linyphiidae (Araneae) from sudeto-carpathian range (Czech Republic and Slovakia). *Acta Soc. Zool. Bohem.* **61**: 389–394.

Vlastimil Růžička

In memory of the late Professor Miller on his 95th birthday

Professor RNDr František Miller, DrSc, was born at Kročehlavy, district of Kladno, on 27 January, 1902, to the family of a supervisor with the State Railways. He graduated from his secondary school with honours. Nevertheless, it was inevitable that he funded his successful university studies at the Natural History Faculty, Charles University in Prague, by giving private lessons or by occasional money earned as an auxiliary with a saw mill.

His pedagogical career started at a teacher's training institute at Štubníanské Teplice, Slovakia, in 1929. Shortly before the tragical event of destruction of Czechoslovakia in 1939, he moved to Žilina where he became regular professor with the



local gymnasium. When Czechoslovakia ceased to exist for the first time, he moved to Jindřichův Hradec in southern Bohemia where he also taught at a gymnasium. Jindřichův Hradec was also the place where his later wife, Jarmila, passed her childhood. Yet due to the fact that during Nazi occupation of this country Jindřichův Hradec was included in the territory of Germany, Miller's Czech school was soon transferred to the territory of the Protectorate Bohemia and Moravia, to a small town of Soběslav.

Shortly after the occupation ended, Miller was appointed director of gymnasium and even Mayor of Soběslav. In 1947, initiated by Professor J. Kratochvíl, he habilitated at the University School of Agriculture and Forestry in Brno as associate professor and head of the Institute of Applied Entomology (later the Chair of Agricultural Entomology and Phytopathology). In 1951–1954 he was appointed dean of the Faculty of Agronomy and in 1954–1958 he was rector of that University. In the 1956 he was nominated ordinary professor. Yet he would come to his department and lecture at the university even after he had retired. And it was on his way to his department that, at the age of 81, he suffered a sudden heart attack so that he was immediately hospitalized and, shortly thereafter, he died on 14 January, 1983.

Professor Miller's great contribution to agricultural science and education and, above all, to Czech, Slovak and world-wide arachnology was significantly influenced already during his university studies. Miller often remembered Professor A. Mrazek (1868–1923) who impressed him not only with his friendly attitude towards his students but, above all, with his unusually wide zoological as well as generally biological knowledge employed in his lectures. It is with this very approach that one would also meet throughout Miller's lifelong pedagogic and scientific activities.

As regards Miller's relation to arachnology, it was characterized, from the very beginning, by his typical systematic accumulation of drawings (Miller thus fully utilized his artistic talent) illustrating all important characters of spiders that came under his hands. His first (largely faunistic) papers bring new data from areas in which he would most frequently stay, such as the environs of Jindřichův Hradec (1934–1936), the environs of Štubníanské Teplice (1936) and the environs of Rakovník, the place where his parents lived (1941). After 1938 Miller established close collegial contact with Josef Kratochvíl (1909–1991) who, although younger, was already more experienced in arachnology. Their cooperation, especially in its initial phase, resulted in a number of joint papers (as many as ten were published in 1938–1940). Their content was more and more taxonomical. It is worthwhile to note especially the revision of the genus *Porrhomma*, of difficult taxonomy, published in a prestigious foreign periodical. This period of Miller's scientific work culminated in the publication of the results of arachnological investigations made at the Mohelno State Nature Reserve. The work was submitted to press in 1942 but did not appear in print until after the liberation of this country, in 1947.

The investigations made at Mohelno yielded an unusually rich array of 284 species collected in a smallish, markedly xerothermic area. Several species were new to science (three of them have stood the recently published revisions) and often the northernmost occurrence of Mediterranean species was the case. In an extreme case (*Cryptodrassus pulchellus*), it was

a member of an endemic genus, still not found outside the territory of the former Czechoslovakia. The paper contains 235 illustrations and a revision of several taxa (*Atypus*, *Micronetac*, *Zoridae*) which significantly exceeds its scope.

After World War II, Miller revised a large number of taxa. In all, he described 114 species, most of which came from his own collections in the territory of the former Czechoslovakia, with his wife, who also helped him, with increasing frequency, finishing his drawings of spiders under his guidance. The name of one of them, *Erigonoplus jarmilae* (Miller, 1947), can be considered a fine expression of her no small merit in arachnology. Many species described by Miller as new to science also came from Kratochvíl's or, later, Polence's collections in the former Yugoslavia, or even from other continents (Afghanistan, Congo). Miller also paid attention to synecological questions, studying spider communities in peat bogs and agrocoenoses and, together with Radoslav Obrtel, in littoral reed beds and a floodplain forest.

Of importance were Miller's extensive contacts with foreign arachnologists. Naturally, I can best appreciate those about which I was immediately informed by Miller himself, that is, after 1958 when we first met. Speaking about his previous contacts, he most frequently mentioned his correspondence with J. Denis (Paris), A. F. Millidge (Great Britain), A. Holm (Uppsala), R. Braun (Mainz) and particularly H. Wichle (Dessau) whom he had met in person. Later, Miller cooperated in a important way with A. Polence (Ljubljana, 2 joint papers) and J. Wunderlich (Germany, extensive correspondence). W. Starcga (Warsaw) and C. Deltchev (Sofia) visited him for a study sojourn. He also published a joint paper with I. Weiss (Sibiu).

Miller's work is still highly appreciated, especially by European arachnologists. So far, ten mostly arachnological taxa have been named in his honour. In 1971, upon the suggestion from the C. I. D. A., the Vth International Congress of Arachnology was organized in Brno and, on this occasion, Professor Miller was elected vice-president of the C. I. D. A. in appreciation of his merits.

Never stopping even in periods when social functions were taking toll of his time, Miller's lifelong work culminated in his „Key to the order Araneida“ (1971). The key comprises over 800 spider species ascertained or presumed to occur in the territory of the former Czechoslovakia.

Still before that time, Miller significantly supported the growing younger generation of arachnologists (J. Martinek, E. Valešová-Žďárková, J. Buchar). Yet the publication of his „Key“ called forth a truly revolutionary upsurge of Czechoslovak arachnology. Miller's perfect illustrations facilitated identification of spiders even to those who were unable to obtain the too numerous foreign literature. The illustrations even gave rise to considerable demand for Miller's „Key“ even in such foreign countries in which the Czech language is utterly incomprehensible. Immediately after the „Key“ appeared in print, an Arachnological section was formed at the Slovak Entomological Society and the numbers and activity of Czech and Slovak arachnologists began increasing.

Nevertheless, the scientific growth of the members of the section mentioned above continued to be significantly supported by personal consultations with Professor Miller. He would take care for his disciples with paternal affection. Whichever of them visited Brno was not allowed to seek night's lodging anywhere else than in Miller's home where the harmonic communion of four generations always deeply impressed the guest. Moreover, it should be noted that even joint papers would gradually originate in these consultations of students with their professor (J. Buchar, J. Svatoň, O. Žitňanská, also P. Sisojevic, a Serbian arachnologist).

It is gratifying to see that Miller's work has found such a great response in the busy activities of Czech and Slovak arachnologists. It is as if Professor Miller were still among us.

I would like to thank to Mrs Jarmila Svobodová, née Millerová, for helpful comments, and to Dr Ing Radoslav Obrtel, CSc, for the translation of the manuscript.

Jan Buchar

BIBLIOGRAPHY

- MILLER F. 1934: Příspěvek k poznání pavoučí fauny Slovenska [Contribution to the knowledge of the spider fauna of Slovakia]. *Příroda* 27: 5–6 (in Czech).
- MILLER F. 1934: Několik vzácnějších pavouků v republice Československé [Several rather rare spiders in Czechoslovakia]. *Věda Přírodní* 15: 106–109 (in Czech).
- MILLER F. 1935: *Trichoneus scrofa* KULCZ. (nec. Sim.) – (Araneae). *Čas. Čs. Spol. Ent.* 32: 26–30 (in Czech, Germ. abstr.).
- MILLER F. 1935: Příspěvek k arachnologickému výzkumu jižních Čech [Contribution to the arachnological research in southern Bohemia]. *Věda Přírodní* 16: 19–21 (in Czech).
- MILLER F. 1935: Dva noví pavouci v naší republice [Two new spiders in our republic]. *Věda Přírodní* 16: 61–63 (in Czech).
- MILLER F. 1936: Einige seltene, für die ČSR neue Spinnenarten. *Čas. Čs. Spol. Entomol.* 33: 186–187.
- MILLER F. 1936: Druhý příspěvek k pavoučí fauně již. Čech [Second contribution to the spider fauna of southern Bohemia]. *Věda Přírodní* 17: 98 (in Czech).
- MILLER F. 1936: Neue Spinnenarten Araneae aus der Čechoslovakischen Republik II. *Festschr. Strand* 2: 563–570.

- MILLER F. 1936: Pavoučí biocenosa vápencových pahorků v okolí Štub. Teplic (Spider community of the limestone hills in the environs of Štubnianské Teplice). *Věda Přírodní* 17: 127–128, 261–264 (in Czech).
- MILLER F. 1938: Neue Spinnen (Araneae) aus der Čechoslovakischen Republik I. *Entomol. Listy* 1: 61–66.
- MILLER F. 1938: Zwei neue Höhlenspinnen aus den Grotten Jugoslawiens. *Festschr. Strand* 4: 629–633.
- MILLER F. & KRATOCHVÍL J. 1938: Quelques nouvelles Araignées pour la faune tchécoslovaque. *Čas. Nár. Muz. Praha* 112: 234–244.
- KRATOCHVÍL J. & MILLER F. 1938: K poznání myrmekofilních pavouků Československa [Contribution a la connaissance des araignées myrmécophiles en Tchécoslovaquie]. *Entomol. Listy* 1: 5–13 (in Czech, French abstr.).
- KRATOCHVÍL J. & MILLER F. 1938: Sur le problème des araignées cavernicoles du genre *Centromerus* de la Péninsule Balkanique. *Mitt. Königl. Naturwis. Inst. Sofia* 11: 1–7.
- MILLER F. 1939: *Trichoncus* *Vejdovskyi* n. sp. (Araneae). *Věst. Čs. Společ. Zool.* 6–7: 318–321.
- MILLER F. & KRATOCHVÍL J. 1939: Einige neue Spinnen aus Mitteleuropa. *Sbor. Entomol. Odd. Nár. Mus. v Praze* 17(163): 32–38.
- KRATOCHVÍL J. & MILLER F. 1939: Espèces nouvelles cavernicoles du genre *Paraleptoneta* (Araneidae) découvertes en Yougoslavie. *Arch. Zool. Exp. Gén.* 80: 96–115.
- KRATOCHVÍL J. & MILLER F. 1939: *Lepthyphantes spelaeomoravicus* n. sp. (Aran.) de la grotte „Býčí skála“ en Moravie. *Sbor. Klubu Pflr. Brno* 22: 1–7.
- MILLER F. & KRATOCHVÍL J. 1940: Einige weitere neue Spinnen aus Mitteleuropa. *Věst. Čs. Společ. Zool.* 8: 59–72.
- MILLER F. & KRATOCHVÍL J. 1940: Ein Beitrag zur Revision der mitteleuropäischen Spinnenarten aus der Gattung *Porrothomma* E. Sim. *Zool. Anz.* 130: 161–190.
- KRATOCHVÍL J. & MILLER F. 1940: Neue Höhlenspinnen der Gattung *Tegenaria* aus Jugoslawien. *Zool. Anz.* 131: 188–201.
- KRATOCHVÍL J. & MILLER F. 1940: Eine neue Spinnengattung der Fam. Eresidae aus Europa. *Věst. Čs. Společ. Zool.* 8: 91–96 (in Germ.).
- MILLER F. 1941: Přispěvek k poznání pavoučí fauny Rakovníka [Contribution to the knowledge of the spider fauna of the Rakovník area]. *Věst. Mus. Spolku Král. Města Rakovníka* 30: 52–67 (in Czech).
- MILLER F. 1943: Neue Spinnen aus der Serpentinsteppen bei Mohelno in Mähren. *Entomol. Listy* 6: 11–29 (in Germ.).
- MILLER F. 1944: *Abacoproeces ascitus* Kulczynski (Aranea). *Entomol. Listy* 7: 13–15.
- MILLER F. 1947: Spiders of the serpentine rocky heath near Mohelno. *Acta Soc. pro Cognitione Cons. Natur. in Moraviae Silesiae* 7: 1–107, tab. 1–16 (in Czech, Engl. abstr.).
- KRATOCHVÍL J. & MILLER F. 1947: Poznámka k znalosti zvířeny pavouků rašelinišť u Rejvízu [Notice a la connaissance des Araignées de la tourbière pres de Rejvíz]. *Entomol. Listy* 10: 112–116 (in Czech, French abstr.).
- MILLER F. & KRATOCHVÍL J. 1948: Notes sur trois espèces du genre *Lepthyphantes* Menge (Araneae). *Entomol. Listy* 11: 137–140 (in Czech, French abstr.).
- MILLER F. 1949: The new spiders from the serpentine rocky heath near Mohelno (Moravia occ.). *Entomol. Listy* 12: 88–99.
- MILLER F. 1951: Arancous-Fauna of the Peat-Bogs near Rejvíz (High-Jeseník). *Pflr. Sbor. Ostrav. Kraje* 12: 202–247 (in Czech, Engl. abstr.).
- MILLER F. 1958: Drei neue Spinnenarten aus den mährischen Steppengebieten. *Věst. Čs. Společ. Zool.* 22: 148–155.
- MILLER F. 1958: Beitrag zur Kenntnis der tschechoslovakischen Spinnenarten aus der Gattung *Centromerus* Dahl. *Čas. Čs. Společ. Entomol.* 55: 71–91 (in Czech, Germ. abstr.).
- MILLER F. 1958: Eine neue *Lepthyphantes* (L. *tranteevi* sp.n.) aus den bulgarischen Höhlen. *Práce Brněn. Zákł. ČSAV* 30: 577–583.
- MILLER F. 1959: Einige neue oder unvollkommen bekannte Spinnenarten aus der Familie der Erigoniden. *Acta Entomol. Mus. Nat. Pragae* 33(532): 41–59.
- MILLER F. 1962: Rad: Araneida [Ordnung: Araneida]. In: PATOČKA J., ČAPEK M. & CHARVAT K. (eds.): Přispěvek k poznání korunové fauny článkonožců na duboch Slovenska, predovšetkým so zreteľom na rad Lepidoptera [Beitrag zur Kenntnis der Arthropoden-Kronenfauna an Eichen in der Slowakei, vor allem unter Berücksichtigung der Ordnung Lepidoptera]. *Biolog. Práce SAV Bratislava* 8(5): 19–20 (in Czech, Germ. abstr.).
- MILLER F. 1963: Tschechoslowakische Spinnenarten aus der Gattung *Euryopis* MENGE (Araneae, Theridiidae). *Čas. Čs. Společ. Entomol.* 60: 341–348.
- MILLER F. & VALEŠOVÁ E. 1964: Zur Spinnenfauna der Kalksteinsteppe des Radotiner Tales in Mittelböhmen. *Čas. Čs. Společ. Entomol.* 61(2): 180–188.
- MILLER F. 1966: Einige neue oder unvollkommen bekannte Zwergspinnen (Micryphantidae) aus der Tschechoslowakei (Araneida). *Acta Entomol. Bohemoslov.* 63: 149–164.
- MILLER F. 1967: Studien über die Kopulationsorgane der Spinnengattung *Zelotes*, *Micaria*, *Robertus* und *Diplocephalus* nebst Beschreibung einiger neuen oder unvollkommen bekannten Spinnenarten. *Acta Sci. Natur. Brno* 7: 253–296.
- MILLER F. 1968: *Sintula buchani* sp. n., eine neue Zwergspinne aus der Tschechoslowakei (Araneidae, Micryphantidae). *Acta Entomol. Bohemoslov.* 65: 241–245.

- MILLER F. 1970: Spinnennarten der Unterfamilie Micryphantidae und der Familie Theridiidae aus Angola. *Publ. Cult. Co. Diam. Angola, Lisboa* 82: 75–166.
- MILLER F. 1971: Řád Pavouci – Araneida [Order Spiders – Araneida]. Pp.: 51–306. In: DANIEL M. & ČERNÝ V. (eds.): *Klíč zvířeny ČSSR 4* [Key to the fauna of the ČSSR 4]. Praha: Nakl. ČSAV, 603 pp. (in Czech).
- MILLER F. & BUCHAR J. 1972: Einige neue Spinnennarten (Araneae) aus dem Hindukusch. *Acta Univ. Carol. – Biol.* 1970: 383–398.
- MILLER F. 1974: Spider fauna of sugar beet fields in the surroundings of Chválkovice and Náklo in Haná. *Acta Univ. Palackianae Olomouc, Fac. Rer. Nat. (47) Biol.* 15: 175–181 (in Czech, Engl. abstr.).
- MILLER F. 1974: Arachnofauna. *Zbor. Prác o Tatran. Nář. Parku, Martin* 16: 75–79 (in Czech.).
- MILLER F. 1975: The history, development and future of arachnological research in the ČSSR. *Z Minulosti a Přítomnosti Turca, Martin* 3: 87–93 (in Czech, Engl. abstr.).
- MILLER F. & OBRTEL R. 1975: Soil surface Spiders (Araneida) in terrestrial reed swamp in southern Moravia (Czechoslovakia). *Acta Entomol. Bohemoslov.* 72: 272–285.
- MILLER F. & OBRTEL R. 1975: Soil surface Spiders in a lowland forest. *Acta Sci. Natur. Brno* 9: 3–39.
- MILLER F. & POLENEC A. 1975: Neue Troglolyphantes-Arten aus Slovenien (Araneae, Linyphiidae). *Acta Entomol. Bohemoslov.* 72: 55–61.
- MILLER F. & POLENEC A. 1975: Centrophanes gen. n. und zwei neue Lepthyphantes-Arten aus Slovenien (Chelicerata: Araneae). *Věst. Čs. Společ. Zool.* 39: 126–134.
- MILLER F. & SVATOŇ J. 1975: Ein Beitrag zur Kenntnis der Spinnenfauna im Gebiet Súľovské skaly. *Monogr. Vlastived. Sbor. Považia* 1: 243–284 (in Slovak, Germ. abstr.).
- MILLER F. & ŽITŇANSKÁ O. 1976: Einige bemerkenswerte Spinnen aus der Slowakei. *Biológia (Bratislava)* 31: 81–88.
- MILLER F. & ŽITŇANSKÁ O. 1976: Ein Beitrag zur Kenntnis der slowakischen Spinnenfauna. *Biológia (Bratislava)* 31: 313–318.
- MILLER F. & BUCHAR J. 1977: Neue Spinnenarten aus der Gattung Zelotes Distel und Haplodrassus Chamberlin (Araneae, Gnaphosidae). *Acta Univ. Carol. – Biol.* 1974: 157–171.
- SISOJEVIĆ P. & MILLER F. 1978: Contribution to the fauna of spiders (Araneida) of Fruska Gora. *Zbor. Priř. Nauke Matice Srbske Novi Sad* 54: 243–253 (in Serb., Engl. abstr.).
- MILLER F. & SVATOŇ J. 1978: Einige seltene und bisher unbekannte Spinnenarten aus der Slowakei. *Annot. Zool. Bot.* 126: 1–19.
- SISOJEVIĆ P. & MILLER F. 1979: Contribution to the arachnofauna of a stand of oak (Quercetum roboris) in Jakovacki Kljuc (Srem, Northern Serbia). *Bull. Mus. Hist. Natur. Belgrad Ser. B* 34: 137–154 (in Serb., Engl. abstr.).
- SVATOŇ J. & MILLER F. 1979: Die Spinnenfauna der staatlichen Naturschutzrezervation Rozsutec. *Kmetianum, Vlast. Sbor. Turčianskeho Múz. A. Kmeti Martin* 5: 177–198 (in Slovak, Germ. abstr.).
- MILLER F. & WEISS I. 1979: Neue Angaben über die Gattung Theonina Simon und Meioneta Hull aus Mitteleuropa. *Věst. Čs. Společ. Zool.* 43: 30–34.
- MILLER F. & BUCHAR J. 1997: Spiders (Chelicerata: Araneae) collected in small mammal nests in the Western Carpathians. *Acta Soc. Zool. Bohem.* 61: 373–379.

Predatory behaviour of four species of jumping spiders of the genus *Evarcha* (Araneae: Salticidae)

Luděk J. DOBRORUKA

Bílá Třemešná 183, CZ–544 72 Czech Republic

Received February 2, 1997; accepted September 16, 1997
Published December 29, 1997

Abstract. Predatory behaviour of *Evarcha laetabunda* (C. L. Koch, 1846), *E. jucunda* (Lucas, 1846), *E. falcata* (Clerck, 1757) and *E. arcuata* (Clerck, 1757) is compared. Interspecific differences were determined almost in whole predatory strategy and capture efficiency. In most instances *E. jucunda* and *E. falcata* are different from both *E. laetabunda* and *E. arcuata*.

Predatory behaviour, predatory strategy, interspecific variation, capture efficiency, Salticidae, *Evarcha*, Araneae

INTRODUCTION

Jumping spiders are mostly diurnal hunters with acute vision, commonly regarded as „versatile predators“, i. e. species with a conditional predatory strategy (Curio 1976). Within one genus substantial interspecific differences are mostly not pronounced, some variation, however, may be observed (Jackson & Hallas 1986, Edwards & Jackson 1993).

The genus *Evarcha* Simon, 1902 includes medium size species (mostly about 5–8 mm body length). In this study the predatory behaviour of four species is compared. *E. arcuata* (Clerck, 1757) and *E. falcata* (Clerck, 1757) belong to the most common salticids in Europe, *E. jucunda* (Lucas, 1846) is common in the Mediterranean, *E. laetabunda* (C. L. Koch, 1846) occurs quite rarely on warm dry localities of Europe.

Following topics are discussed: predatory strategy; distance a spider jump to capture prey; spider's position relative to its prey at the time of attack; the aim of the attack; capture efficiency; success on the first try.

MATERIAL AND METHODS

Four males and 6 females of *E. arcuata* and 5 males and 3 females of *E. falcata* were captured on several localities in eastern Bohemia, Czech Republic, 3 males and 5 females of *E. jucunda* were captured in Punat, island Krk, and in Čikat, island Lošinj, Croatia, 2 females of *E. laetabunda* originated from the National Park Podyji in southern Moravia, Czech Republic. All specimen were adult. The spiders were kept and tested in glass jars 10 cm high and 6 cm in diameter, each equipped with a piece of thin twig. As a prey different species of Diptera (Fruit Fly *Drosophila* sp., Lesser House Fly *Fannia* sp., Common House Fly *Musca domestica*, Greenbottle Fly *Lucilia* sp., *Ulidia* sp., Window Midge *Phryne fenestralis*, Window Fly *Scenopinus* sp., Chironomid Midge *Chironomus* sp., Mosquito *Culex* sp. and *Aedes* sp.), Jasiid cicada (*Empoasca* sp.) and 2 species of Aphids (Rose Greenfly *Arge rosae*, Elder Aphid *Aphis sambuci*) were used randomly. If the spider didn't react on the prey for 15 minutes, the test was finished. Three sizes of prey were defined by dividing estimated prey volume by the estimated volume of the spider: small (about half the body size of the spider), medium (about equal to the size of the spider), large (up to 50% larger than the spider).

In total, 469 attacks were tested (144 in *E. arcuata*, 122 in *E. falcata*, 116 in *E. jucunda* and 87 in *E. laetabunda*).

Two modes of prey capture were defined (see Richman & Jackson 1992). Active searching: the spider walks and stops periodically to look around; visual scanning: the spider scans visually the environment from one place, then actively stalks

prey that comes near. The spider's position relative to its prey at the time of attack was classified as follows: if the prey was facing more or less directly toward the facing spider, the position was „anterior“; if the prey was facing more or less directly away from the facing spider, the position was „posterior“; if the prey was oriented about perpendicular to the facing spider, the position was „lateral“. The aim of attack, i. e. the place of the body where the spider grabs and stabs its prey, was stated as head, thorax and abdomen, respectively. The capture efficiency was defined as the number of attacks in which the prey was captured divided by number of pursuit (attacks without capture success) and multiplied by 100 (see also Jackson & Hallas 1986). The efficiency was determined a) separate for all three spider's positions relative to its prey, b) in total. The success on the first try was evaluated according to the size of prey and according to the spider's position relative to its prey at the time of attack.

If statistically evaluated, data were tested by T test and χ^2 test. If not exactly evaluated, then expressions such as „usually“, „sometimes“ and „infrequently“ were used to indicate frequencies of occurrence of about 80% and more, 20–80% and 20% or less, respectively.

RESULTS

Predatory strategy

In absence of prey *Evarcha* usually sits at one place scanning visually the environment. If the prey occurs or comes near, the spider „swivels“ (cephalothorax pivots so that the principal eyes face the prey – see Forster 1977), then stalks and leaps on it. The usual way of approaching the prey is stalking with short pauses. In *E. jucunda* and *E. falcata* the spiders sometimes approach the prey which is on longer distance altering stalking with short leaps. This behaviour was never seen in *E. laetabunda* and/or *E. arcuata*. If the prey is too large the spider often leaps toward it without trying to catch it, the leap is too short and, if the prey does not escape, then the spider

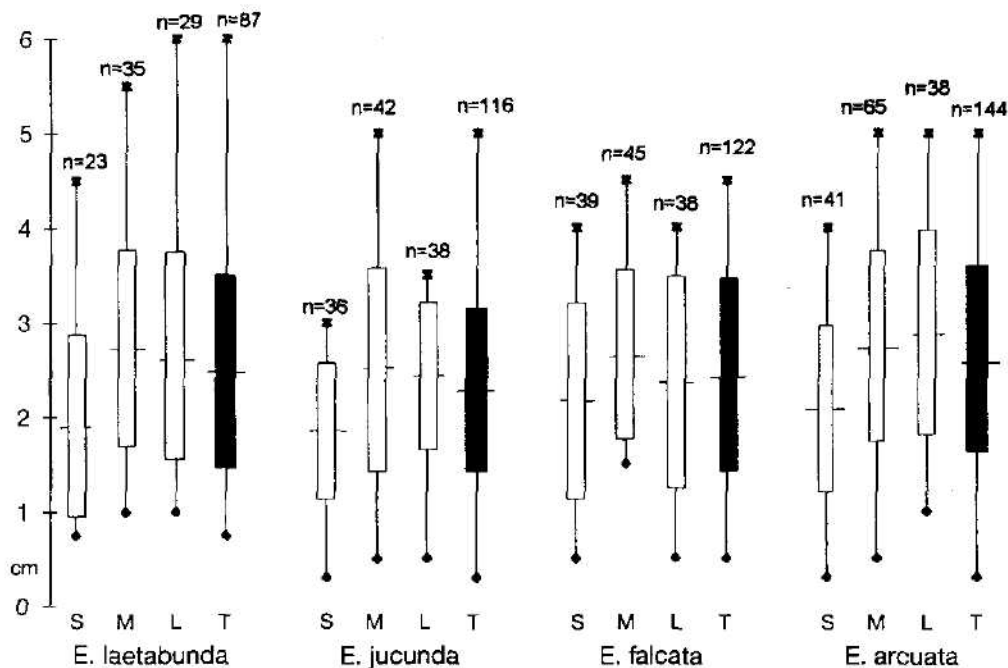


Fig. 1. Distance a spider jump to capture prey (mean, $\pm$ standard deviation and range) separately for small (S) middle (M) and large (L) prey and in total (T) in each species. Spider species are listed by increasing mean length.

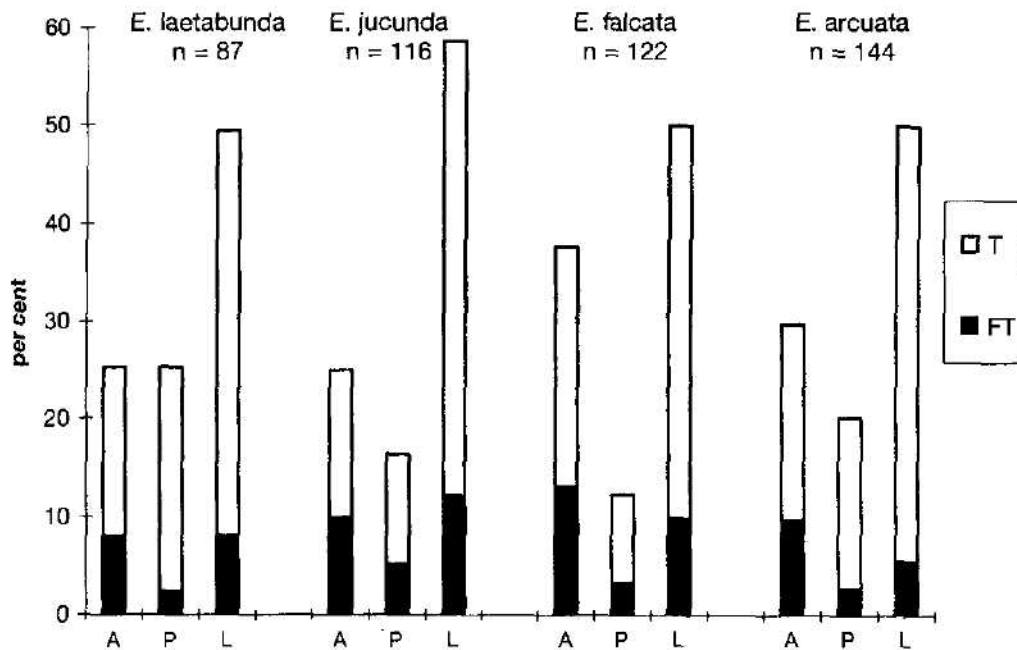


Fig. 2. Percentage of attacks from each of three orientations (A = anterior, P = posterior, L = lateral). T = total, FT = percentage of attacks successful on the first try.

leaps away. Such instances were classified as deterrent strategy or defense reaction. Such behaviour, however, was not determined for *E. laetabunda*. Sometimes the spider watches the prey for some time before approaching it. Infrequently the spider watches the moving prey only and begins to stalk afterwards the prey stops at some time. In such instances the spider comes usually very close to the prey. The success in such instances is very high.

E. jucunda and *E. falcata* perform sometimes short simple detours in situations when the prey stops and remains stationary for some time.

Immediately reaction on the prey is not routine in predatory sequences of *Evarcha*. Sometimes the spider ignores the prey for a variable period (up to 10 min) before suddenly starting a predatory sequence („suddenly activation“).

The mode of visual scanning was used in *E. laetabunda* in 89.7%, in *E. jucunda* in 91.7%, in *E. falcata* in 89.3% and in *E. arcuata* in 78.38% of investigations. The mode of active searching was used mostly in situations when the spider attacked more times middle or large prey without catching it and consequently changed the place before finding a new one for visual scanning again.

Distance a spider jump to capture prey

If compared regardless to the size of the prey, no significant differences were found within four investigated species (Fig. 1). In *E. arcuata*, *E. jucunda* and *E. laetabunda*, however, the distance of the attack was significantly shorter in small prey ($p < 0.01$), while the distance of the

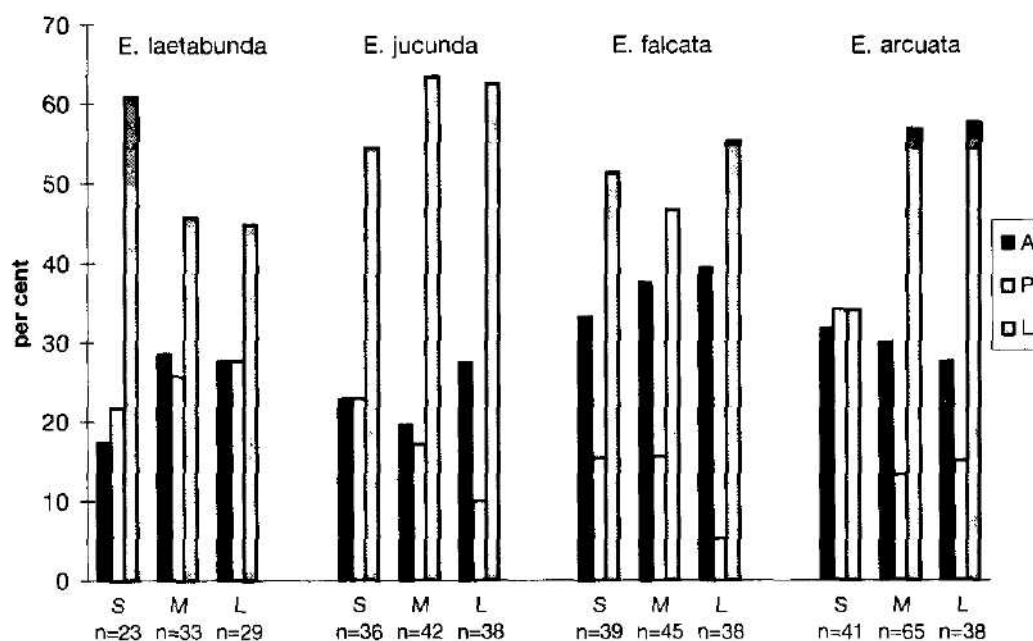


Fig. 3. Percentage of attacks from each of three orientations (A = anterior, P = posterior, L = lateral) in dependence on the size of the prey (S = small, M = middle, L = large).

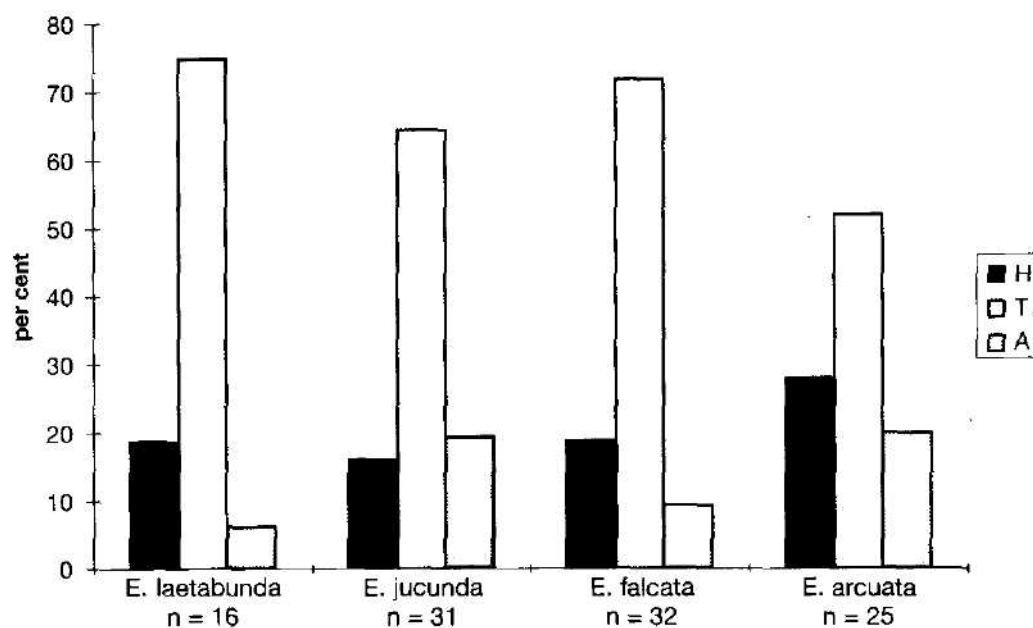


Fig. 4. Aim of successful attacks (H = head, T = thorax, A = abdomen).

attack on the prey of middle or large size was not significantly different. In *E. falcata* the differences in the distance of attack in all size categories were not significant.

Spider position relative to its prey at the time of the attack

Fig. 2 shows the position of the spider at the time of attack regardless to the size of the prey. In all species the prey was attacked most often from lateral. On the second place they are anterior attacks and at least are used attacks from posterior. In *E. laetabunda* the anterior and posterior attacks were used equally often. Some interspecific differences may to be observed, however, if compared the position of the spider in dependence on the size of the prey (Fig. 3). In all species the attacks were most often provided from lateral, except in *E. arcuata*, which attacks small prey regardless to the position, while it makes significant differences in attacking the prey of middle or large size. *E. jucunda* makes no significant differences in attacking small and middle sized prey from anterior and/or posterior and, *E. laetabunda* attacks prey of all sizes quite equally often from both anterior and posterior positions.

Aim of the attack

All investigated species of *Evarcha* aim their attack most often at the thorax of the prey (Fig. 4). In *E. laetabunda*, *E. jucunda* and *E. falcata* the preference is significant ($p < 0.01$), in *E. arcuata* the differences are not significant. The differences in number of attacks directed to the head and to the abdomen of the prey were slightly different but not significant in investigated species.

Capture efficiency and success on the first try

In all investigated species the highest efficiency was in attacking small prey, lower efficiency was in capturing middle sized prey and lowest in large sized prey (Fig. 5). Without exception the

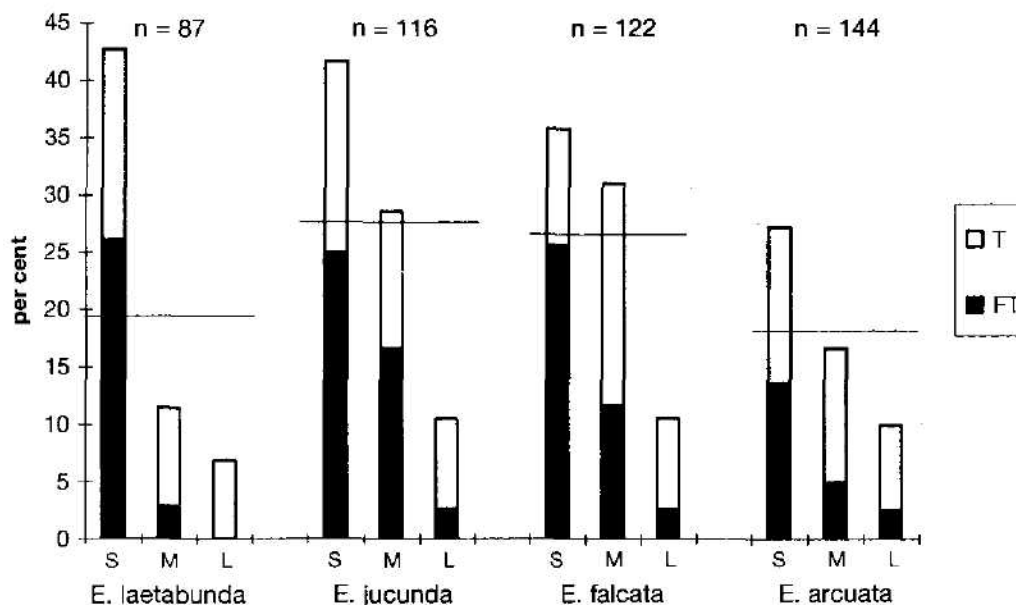


Fig. 5. Percentage of efficiency of attacks in dependence on the size of the prey (S = small, M = middle, L = large). T = total, FT = percentage of efficiency on the first try. Horizontal lines indicate total efficiency regardless to the size of prey.

success on the first try was achieved most often in small prey (which was attacked from significantly shorter distance – see above). The total efficiency in *E. jucunda* and *E. falcata* (26.72% and 26.23%, respectively) is higher than total efficiency in *E. laetabunda* and *E. arcuata* (18.39% and 18.06%, respectively). The most successful predator among investigated *Evarcha* seems to be *E. jucunda*, which succeeded on the first try in 54.8% of attacks, closely followed by *E. falcata* with 50% success on the first try. *E. laetabunda* succeeded on the first try in 43.75% and less successful seems to be *E. arcuata* with 38.46% success on the first try.

As to the success on the first try in dependence on the spider position relative to its prey the less successful were attacks from posterior. In successes of anterior and lateral attacks no significant differences were found (Fig. 2).

DISCUSSION AND CONCLUSION

Up to the present the predatory behaviour was studied before all in „unusual“ or „aberrant“ araneophagic jumping spiders of the subfamily Spartheinae (mainly in *Portia*) and in some ant-eating jumping spiders. Among jumping spiders in which most common prey seems to be adult Diptera the most precise studies were carried out on the genus *Phidippus* (Gardner 1965, Freed 1984, Edwards & Jackson 1993, and m. o.). The present study is the first one dealing more comprehensively with the comparison of predatory behaviour in four species of *Evarcha*.

Following results were achieved:

- 1) All investigated species use visual scanning as the principal mode of predation.
- 2) *Evarcha jucunda* and *E. falcata* perform sometimes simple short detours when the moving prey stops and remains stationary for some time. For *E. laetabunda* and *E. arcuata* such detours were not determined. The fact that *E. falcata* takes short detours to attack prey was published, without nearer explanation, already (Heil 1936). Whether the detours to motionless but not to moving prey are obvious needs further investigations (cf. Tarsitano & Jackson 1992).
- 3) In *E. arcuata*, *E. jucunda* and *E. laetabunda* (but not in *E. falcata*) the distance on which the spider attacks its prey is significantly shorter ($p < 0.01$) in small prey than in middle or large prey.
- 4) Very large prey is sometimes not attacked but the leap close to it with subsequently leap away from it is used as deterrent behaviour.
- 5) If compared regardless to the size of prey, *Evarcha* attacks its prey most often from lateral, at least were used attacks from posterior. Interspecific differences are present, however, if compared the position in dependence on the size of the prey. It supports the statement of prey-specific predatory behaviour in Salticidae in which the method of attack is influenced by the size of the prey (Drees 1952, Dill 1975, Gardner 1965, Freed 1984). In this respect the genus *Evarcha* differs from the genus *Phidippus*, which significantly prefers to attack its prey from posterior (Edwards & Jackson 1993).
- 6) *Evarcha* aims their attacks mostly toward the thorax of the prey. In *E. laetabunda*, *E. jucunda* and *E. falcata* this preference is significant ($p < 0.01$). In this respect it corresponds with observations in *Phidippus*, too (Edwards & Jackson 1993, Jackson & Pollard 1996).
- 7) Capture efficiency in all investigated species was highest in small prey. The efficiency decreases with the raising size of the prey. In spite of the supposition that cursorial salticids tend to be very effective predators of motile insects (Jackson & Hallas 1986) the efficiency of *Evarcha* is rather low (highest in *E. jucunda*, where it is 26.72%). It supports the hypothesis that euryphagous predators employ more generalized, unspecialized predatory behaviour of „vestigial pred-

ators", which is less effective than a specialized behaviour in stenophagous predators (Jackson 1986, Jackson & Van Olphen 1991).

8) The investigated species differ in success at capturing the prey on the first try, too. In *E. jucunda* and *E. falcata* the success on the first try is higher than in *E. laetabunda* and *E. arcuata* ($p < 0.01$). The highest capture rate on the first try in species of middle size in comparison with larger and/or smaller species of the same genus was noted in the genus *Phidippus*, already (Edwards & Jackson 1993).

9) Further investigations are needed, however, to determine to which extent conditional strategies and/or eventually interspecific variation in predatory behaviour are responsible for exhibited differences (Jackson 1992). Another problem to be solved are possible differences in predatory behaviour employed in different subfamilies of jumping spiders (Jackson & Van Olphen 1992).

REFERENCES

- CURIO E. 1976: *The ethology of predation*. Berlin: Springer Verlag, 250 pp.
- DILL L. M. 1975: Predatory behaviour of the zebra spider *Salticus scenicus* (Araneae, Salticidae). *Can. J. Zool.* **53**: 1284–1289.
- DREES O. 1952: Untersuchungen über die angeborenen Verhaltensweisen bei Springspinnen. *Ztschr. Tierpsychol.* **9**: 169–207.
- EDWARDS G. B. & JACKSON R. R. 1993: Use of prey-specific behaviour by North American jumping spiders (Araneae, Salticidae) of the genus *Phidippus*. *J. Zool. Lond.* **229**: 709–716.
- FORSTER L. M. 1977: A quantitative analysis of hunting behaviour in jumping spiders (Araneae: Salticidae). *N. Zeal. J. Zool.* **4**: 51–62.
- FORSTER L. M. 1979: Visual mechanisms of hunting behaviour in *Trite planiceps*, a jumping spider (Araneae: Salticidae). *N. Zeal. J. Zool.* **6**: 79–93.
- FREED A. N. 1984: Foraging behaviour in the jumping spider *Phidippus audax*: bases for selecting. *J. Zool. Lond.* **203**: 49–61.
- GARDNER B. T. 1965: Observations on the species of *Phidippus* jumping spiders (Araneae, Salticidae). *Psyche* **72**: 133–147.
- HEIL K. H. 1936: Beiträge zur Physiologie und Psychologie der Springspinnen. *Ztschr. Vergl. Physiol.* **23**: 125–149.
- JACKSON R. R. 1986: Web building, Predatory versatility, and the Evolution of the Salticidae. Pp.: 232–236. In: SHEAR W. A. (ed.): *Spiders: webs, behavior and evolution*. Stanford, California: Stanford Univ. Press.
- JACKSON R. R. 1992: Conditional strategies and interpopulation variation in the behaviour of jumping spiders. *N. Zeal. J. Zool.* **9**: 99–111.
- JACKSON R. R. & HALLAS S. E. 1986: Capture efficiencies of web-building jumping spiders (Araneae, Salticidae): is the jack-of-all-trade the master of none? *J. Zool. Lond. (A)* **209**: 1–7.
- JACKSON R. R. & POLLARD S. D. 1996: Predatory behaviour of jumping spiders. *Annu. Rev. Entomol.* **41**: 287–308.
- JACKSON R. R. & VAN OLPHEN A. 1991: Prey-capture techniques and prey preferences of *Corythalia canosa* and *Pystira orbiculata*, ant-eating jumping spiders (Araneae, Salticidae). *J. Zool. Lond.* **223**: 577–592.
- JACKSON R. R. & VAN OLPHEN A. 1992: Prey-capture techniques and prey preferences of *Chrysilla*, *Natta* and *Siler*, ant-eating jumping spiders (Araneae, Salticidae) from Kenya and Sri Lanka. *J. Zool. Lond.* **227**: 163–170.
- RICHMAN D. B. & JACKSON R. R. 1992: A review of the ethology of jumping spiders (Araneae, Salticidae). *Bull. Br. Arachnol. Soc.* **9**: 33–42.
- TARSITANO M. S. & JACKSON R. R. 1992: Influence of prey movement on the performance of simple detours by jumping spiders. *Behaviour* **123**: 106–120.

Glandular hairs of spiders of the genus *Atypus* (Araneae: Mygalomorphae)

Jaromír HAJER

Department of Biology, Purkyně University, České mládeže 8, CZ–400 96 Ústí nad Labem, Czech Republic

Received September 17, 1996; accepted September 16, 1997
Published December 29, 1997

Abstract. Glandular hairs which are present on the posterior lateral and posterior median spinnerets in spiders of the genus *Atypus* Latreille, 1804 were studied. The surface of glandular hairs or their ultrastructure, does not differ from the structure of the other hairs covering the spinnerets excepting their onion-shaped broadening basal parts. There are no openings or pores on the sides of the glandular hairs through which the secretion could flow out onto their surface. During the spinning activity the spinnerets rub onto the substrate and the very ends of the glandular hairs break off. The secretion flows out through the openings so created in the form of tiny droplets, which stick to the threads of the web and fasten them to the substrate as well as to one another. The liberation of the secretion is absolutely spontaneous and takes place during any spinning activity. This is a remarkable way of attaching silk to the substrate different from the use of attachment discs by araneomorph spiders.

Spinning activity, glandular hairs, Araneae, Mygalomorphae, Atypidae

INTRODUCTION

Evolution of the order Araneae occurred most probably through 3 major evolution lines, currently represented by the suborders Mesothelae, Mygalomorphae, and Araneomorphae. Coddington & Levi (1991) regard those suborders as the three major monophyletic groups of spiders. The suborders exhibit differences in the structure of some important organs, among the most remarkable of which is the spinning apparatus, through which the spinning activity – a prominent feature of spiders – occurs.

The spinning apparatus comprises spinnerets and spinning glands attached to them. There exist several categories of spinning glands, which differ both morphologically and histologically. The glands end on the surface of the spinnerets with two-part spigots, which are generally regarded as metamorphosed hairs. As well as the spinning glands, the spigots are classed into several types. Spinnerets appear to arise embryologically from the same longitudinal series of „limb buds“ which give rise to the prosomal appendages, i. e. chelicerae, pedipalps and walking legs (Dawydoff 1949). Attempts have been made (Brown 1945, Whitehead & Rempel 1959) to homologize the muscles of spinnerets with those of prosomal appendages but their results were not very convincing and have not been widely accepted. Additional investigations, however, gave evidence that the spinnerets of mygalomorphs can be seen to move in time with the walking legs during locomotion (Seyfarth 1985). Schultz (1987) suggested that these appendages share a serially arranged motor control mechanism as well as similar developmental origins. Kautsch (1910) found that in the spider *Agelena labyrinthica* (Clerk, 1757), respiratory organs have developed extremities on the bases of the 8th and 9th body segments and spinnerets on the 10th and 11th segments. Yoshikura (1955) confirmed Kautsch's conclusions in his study of the spider *Heptathela kimurai* Kishida, 1920 (Mesothelae). The suborder Mesothelae includes probably the most ancient recent spiders with markedly segmented abdomens as well as more anteri-

or positions of the spinnerets. Informations on a silk-gland system in Mesothelae was given in detail by Haupt & Kowoor (1993).

In the majority of the recent spiders of the suborders Mygalomorphae and Araneomorphae, the spinnerets are located at the posterior end of the abdomen. Spiders of the genus *Liphistius* Schiödte, 1849 (Mesothelae: Liphistiidae) are equipped with the highest number – four pairs – of spinnerets, which means that both the 8th and the 9th segments bear each a pair of multisegmented lateral spinnerets and a pair of monosegmented median spinnerets. Except for Mesothelae, four pairs of spinnerets are never formed since the anterior median pair is not developed. One of the prominent features of spiders of the suborder Mygalomorphae, which, like Mesothelae, live frequently in tubular web shelters, is the tendency to a reduction of the number of spinnerets, which undoubtedly brings about a limited diversity of spinning glands, spigots, and produced silk. In all mygalomorphs the anterior median spinnerets are completely extinct, and a great number of these spiders has also reduced or nonfunctional anterior lateral spinnerets. In the suborder Araneomorphae, with the highest species abundance, the anterior median spinnerets are transformed into a nonfunctional rudiment called colulus or, alternatively, into an additional organ called cribellum. The present study was aimed at the investigation of a special group of hairs and the corresponding glands, whose secretion affects the structure and mechanical properties of webs built by purse-web spiders. A description of the spinning apparatus of spiders of the genus *Atypus*, including glandular hairs, has been presented by Glatz (1972, 1973). Peculiarities of the spinning apparatus in the first two nymphal stages have been investigated by Hajer (1993). Atypidae possess three pairs of spinnerets. The anterior lateral spinnerets (ALS) are invariably monosegmental, and only in the first two nymphal stages of the ontogenetic cycle, each of them is equipped with one spigot associated with a single gland. In all the subsequent stages of the ontogenetic cycle the spigots as well as glands are reduced and their ALS are incapable of spinning activity (Hajer 1993). The posterior median spinnerets (PMS) are also monosegmental, equipped with three types of spigots and glands. The posterior lateral spinnerets (PLS) are tetrasegmental in the species *Atypus muralis* and trisegmental in the species *A. piceus* and *A. affinis* and two types of glands end on their surface through spigots. As found by Glatz (1973), the spinning glands of the genus *Atypus* produce either an acidophilic secretion only, or – in the case of bisegmental glands – both acidophilic and basophilic secretions.

MATERIALS AND METHODS

The material studied comprised specimens of 3 spider species belonging to the genus *Atypus* Latreille, 1804:

1. *Atypus affinis* (Eichwald, 1830) – 16 nymphs of the 1st instar, 18 nymphs of the 2nd instar, 6 adult females, 22 adult males.
2. *Atypus piceus* (Sulzer, 1776) – 18 nymphs of the 2nd instar, 3 adult females, 7 adult males.
3. *Atypus muralis* (Bertkau, 1890) – 9 nymphs of the 1st instar and 3 adult females.

The major part of the material, including cocoons with spiderlings was collected in the České Středohoří Mts., northern Bohemia. The all specimens of *A. muralis* were found by M. Antuš in Prokopské údolí valley, in Praha.

Classification of the postembryonic stages in this work was based on the studies by Yoshikura (1958), Downes (1985), and Galiano & Goloboff (1996).

The specimens were fixed in Bouin's fluid and the spinning apparatus was dissected, dehydrated in ethanol of graded strength, embedded in paraplast, and sectioned at 6–10 µm. The serial paraplast sections were stained by using the „Azan“ method. The spinning apparatus was examined under a JENAMED-2 light microscope and a TELAVAL-3 inversion microscope. For SEM studies the spinning apparatus was removed and the spinnerets were dehydrated in ethanol and critical point dried with carbon dioxide. After sputtering with gold, the spinnerets were analyzed by using a TESLA BS-340 scanning electron microscope. Exuviae embedded in the Swann fluid were also used to determine the number of hairs and examine their internal structure.

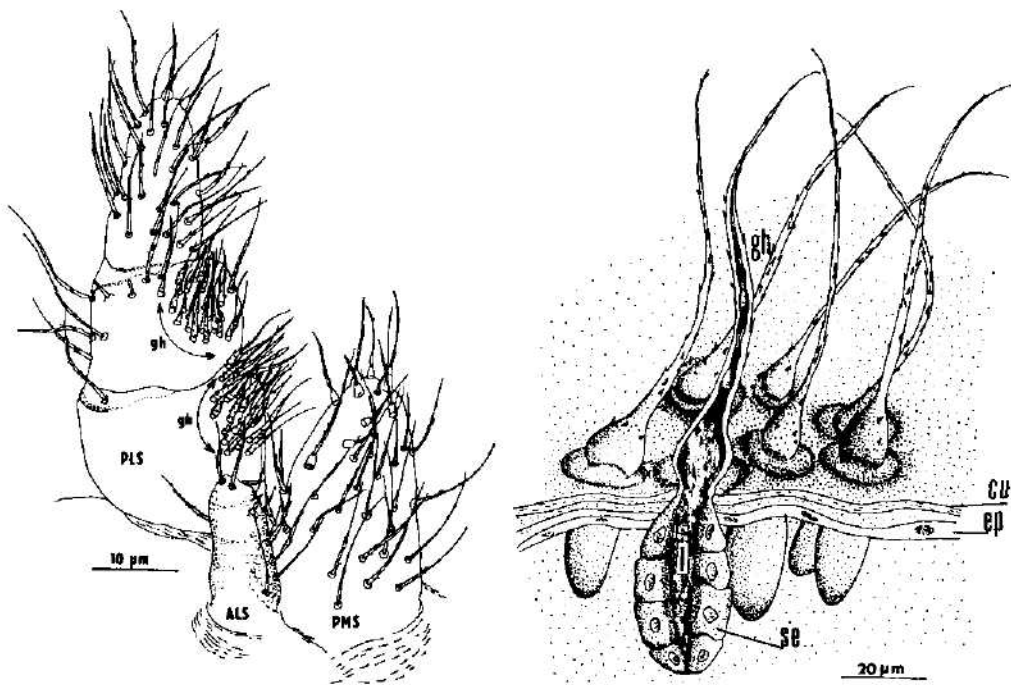
Attention was paid to the microstructure of the webs and, in particular, to the way the individual threads are fastened to the substrate as well as to one another. For this purpose the spiders in the various developmental stages were kept in plastic boxes and in cotton-stoppered vials containing microscope glasses, which were removed after being wrapped by the web.

RESULTS

The web produced by spiders of the genus *Atypus* has the form of a densely woven tube which can reach length up to 30 cm (Fig. 4). Its longer part is fixed in earth and serves as a shelter and place for copulation. The shorter, cigar-shaped part lies on the surface of the soil and serves for catching prey (Figs 4–6).

Position and number of glandular hairs

Glandular hairs of spiders of the family Atypidae are present on the posterior median spinnerets (PMS) and posterior lateral spinnerets (PLS) (Fig. 1). Each hair is associated with a tiny gland whose length and width can reach 70 μm and 30 μm , respectively, in adult spiders (Fig. 2). Nevertheless the shape of these glands is not constant. Some of them are tubular, spherical or ovoid in a shape. On monosegmental PMS the glandular hairs are located on the caudal side, whereas on the trisegmental PLS in the species *Atypus piceus* and *A. affinis* and tetrasedgmental PLS in the species *A. muralis* the glandular hairs are located on the median side of all of the segments.



Figs 1–2. Fig. 1. *Atypus piceus* (Sulzer), nymph of the 2nd instar. The right-hand half of the spinning apparatus. ALS – anterior lateral spinneret, PMS – posterior median spinneret, PLS – posterior lateral spinneret, gh – glandular hairs. Fig. 2. *A. piceus*, adult female. Battery of glandular hairs and their glands; cu – cuticle, e – epidermis, sc – secretory epithelium, l – lumen, gh – glandular hairs.

Nymphs of the 2nd instar are the first postembryonal stage in which the batteries of glandular hairs appear. The groups encompass 38 to 42 hairs on each PMS and 77 to 88 in total on the PLS – out of this 48–52 on the basal segment and only 2 to 3 on the apical segment.

In adult females as well as males the number of glandular hairs is multiply higher, reaching several hundred. On the PMS the number of hairs is within the range of 280 to 320, on each PLS the total number of glandular hairs is 860 to 900, out of which roughly one-half is on the basal segment. There are no differences in the number of hairs between males and females but appreciable differences appear in the amount of secretion accumulating inside the hairs (see later).

Structure of the glandular hairs and their glands

Characteristic and most marked is the onion-shaped broadening of the base of the glandular hairs, attaining 7 to 12 μm in diameter in adult specimens. The total length of the hairs in adults is 25 to 60 μm . The hairs grow narrower along their length and the cavities inside their basal parts continue as channels passing through the hair. The channels do not branch and have no side openings.

The glands lie immediately below the cuticle and end directly in the broadened hair base, which undoubtedly functions as a reservoir. This situation is quite unusual in comparison with the other types of spinning glands and is presumably associated with the small size of the gland lumina which cannot function as reservoirs. Very often the apical part of the gland including the secretion epithelium penetrates directly into the cavity inside the hair so that the secretion also takes place directly within the reservoir (Figs 10–11).

In 2nd stage nymphs killed immediately after ecdysis, both the lumina and the reservoirs and/or channels in the hairs were full of the secretion. In adult females the secretion epithelium cells produce acidophilic secretion during their whole life whereas in adult males this kind of secretion activity ceases gradually and the cavities inside the hairs are empty or contain only remains of the dry secretion. It should be noted that adult males do not build their own webs or hunt food. All their life activities are primarily aimed at finding female webs and mating with females.

The glandular hair reservoirs in adult males are only filled with the secretion immediately after attaining their sexual maturity, i. e. after the last ecdysis.

The surface of the glandular hairs, or their ultrastructure, does not differ in any respect from the structure of the other „normal“ hairs covering densely the spinnerets. In both cases, scaly pointed outgrowths similar to those occurring on the surface of hairs of spiders of the suborder Araneomorphae were observed (Figs 8–9).

Thus the above-mentioned broadened hair base and the distal parts of the hairs glued with secretion are the basic outer discriminating marks (Fig. 7).

Releasing the secretion onto the surface of the hairs and spinnerets

As mentioned earlier, there are no openings or pores on the sides of the glandular hairs through which the secretion could flow out onto their surface. Acidophilic secretion produced by the secretion epithelium of the glands concentrates in the cavities of the basal parts of the hairs, each continuing as a gradually narrowing channel towards the tip of the hair. During the spinning activity the spinnerets rub vigorously onto the substrate and the very ends of the glandular hairs break off (Fig. 8). The secretion flows out through the openings so created in the form of tiny droplets, which stick to the threads of the web and fasten them to the substrate as well as to one another (Figs 5–6). When examining all threads in detail, hardly any is found to be free from droplets of the viscid fluid. The liberation of the secretion is absolutely spontaneous and

takes place during any spinning activity, particularly during the building of the tubular shelter, renewal of its lining, and building of the egg-sac.

DISCUSSION AND CONCLUSIONS

The suborder Mygalomorphae currently involves 15 families with approximately 260 genera and 2200 species (Coddington & Levi 1991). The ontogenetic cycle, whose detailed knowledge could contribute substantially to a deeper insight into the phylogenetic evolution, is unknown for the vast majority of species.

According to Galiano & Goloboff (1996), various aspects of ontogeny have been recognized for about 30 mygalomorph spider species. For the vast majority of spiders we do not know what kinds of change take place in the spinning activity or in the structure of the spinning apparatus during their life cycle. We know that Mygalomorphae are more diverse than Mesothelae (2 genera, about 40 species) but less diverse than Araneomorphae (90 families, 2700 genera and 32 000 species). As stressed in the Introduction, a tendency to reduction of the spinning apparatus is typical of spiders of the suborder Mygalomorphae. The anterior median spinnerets vanish in all mygalomorphs and are never transformed into the cribellum or, alternatively, the colulus. Comparison of the spinning activity of spiders of the suborders Mygalomorphae and Araneomorphae shows that the loss of AMS did not affect the evolution of webs of mygalomorphs as appreciably as the reduction of the ALS did. In spiders of the suborder Araneomorphae, both glandulae ampullaceae and glandulae piriformes open on the surface of the ALS. Drag-lines and attachment discs are formed from the silk of those glands. According to one of the theories on

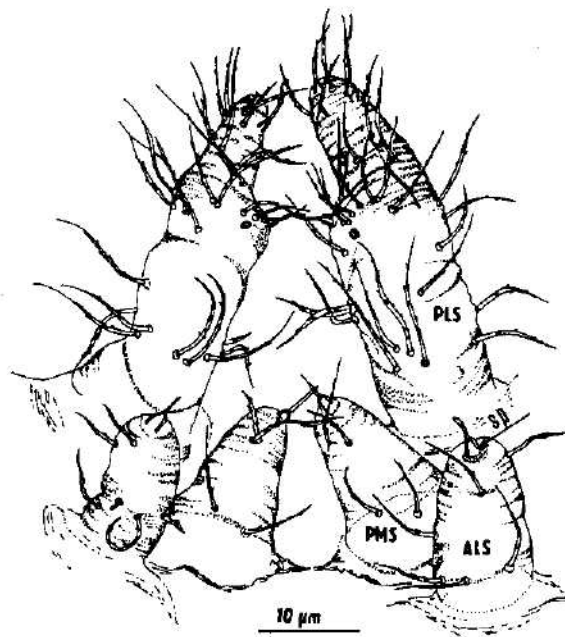
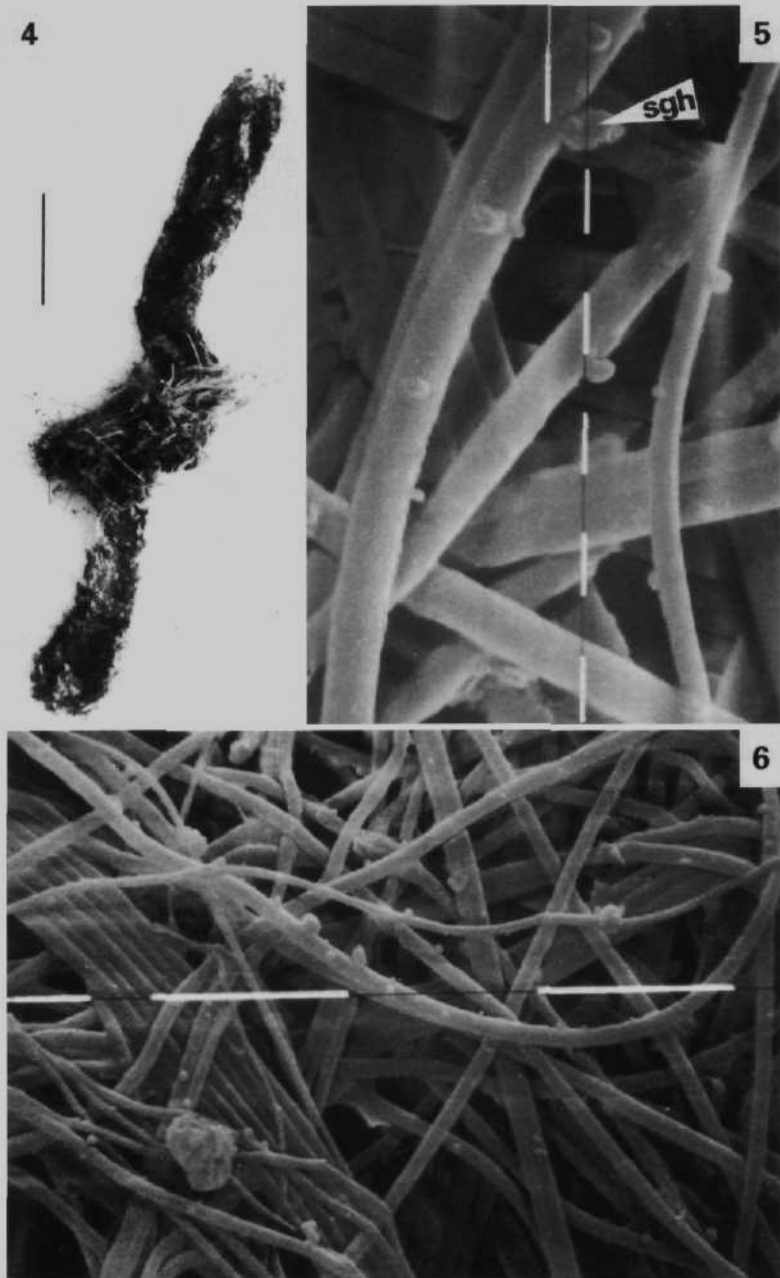
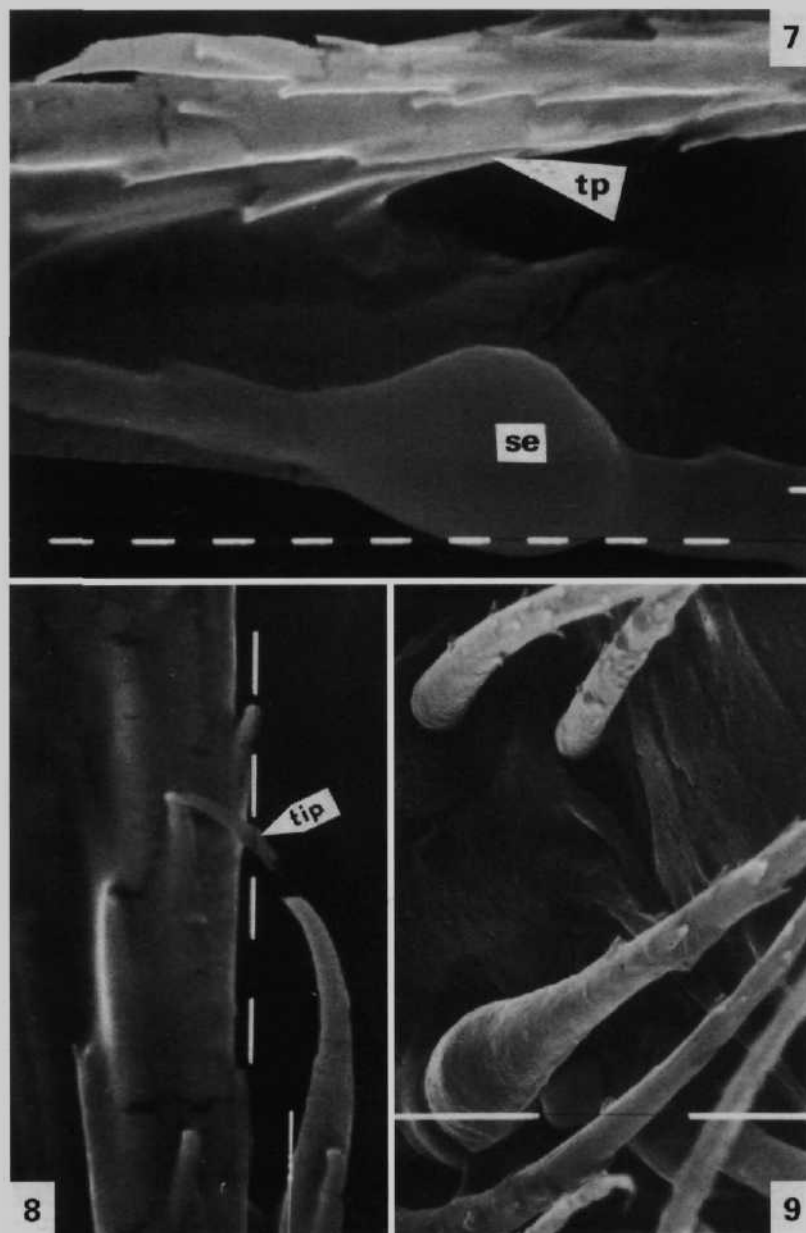


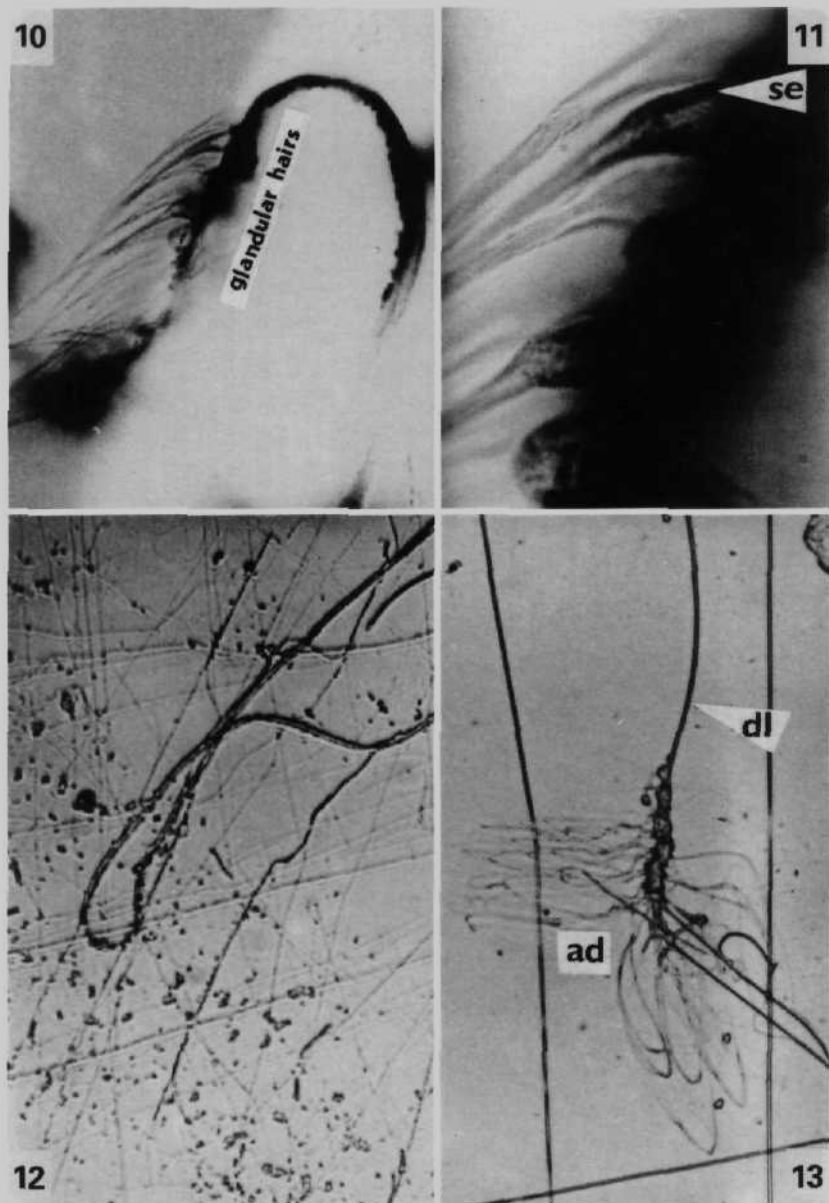
Fig. 3. *Atypus muralis* (Bertkau), the spinning apparatus of the first nymphal stage. ALS – anterior lateral spinneret, PMS – posterior median spinneret, PLS – posterior lateral spinneret, sp – spigot. Glandular hairs are not developed in this stage.



Figs 4–6. 4 – web of a female of the species *Atypus piceus* (Sulzer). The aerial (upper) part of the web tube is separated from the buried (lower) part by a small tuft of dry grass. The length of the abscissa is 2 cm. 5, 6 – detail of the inner side of the web, whose threads are glued together by secretion flowing from the glandular hairs (sgh). Magnification: 5 – 500 $\times$, 6 – 640 $\times$. Scale line: 1 μ m (Fig. 5), 10 μ m (Fig. 6).



Figs 7–9. *Atypus piceus* (Sulzer), adult female. 7 – detail of the terminal part (tp) of a glandular hair. Dry secretion (se) is visible on the surface of the majority of hairs. Magnification 5000 $\times$, scale line 1 μ m. 8 – rubbed against a substrate, the tips of the glandular hairs break off and the secretion flows out onto the surface of the hairs. Magnification 5000 $\times$, scale line 1 μ m. 9 – comparison of the structure of the surface of glandular hairs (bottom) and „normal“ hairs (top, 2 hairs). While the microstructure of the surface is the same for the two kinds of hair, the thickness of the basal parts is different. Magnification 1250 $\times$, scale line 10 μ m.



Figs 10–13. 10 – *Atypus affinis* (Eichwald), adult female. Longitudinal section of the posterior median spinneret. Magnification 720 $\times$. 11 – detail of the previous photograph. The secretion epithelium is visible in the broader basal part. Magnification 1760 $\times$. 12 – web of an adult female of the species *Atypus piceus*, spun within 24 h on the surface of a microscope glass. The finest threads, spun as the first, are fastened to the substrate by viscid droplets of the secretion flowing from the glandular hairs. Only onto this fine attachment system are laid additional web threads whose thickness corresponds to the size of the spigots. Magnification 740 $\times$. 13 – *Cyrtophora citricola* (Forsk.) adult female (suborder Araneomorphae, family Araneidae). The web threads, as well as the drag-lines (dl), are fastened to the substrate by means of attachment discs. Magnification 740 $\times$.

the original function of spider silk, known as the drag line theory (Savory 1960, 1977), the drag line is the most original way of utilizing the spider silk. Advocates of this theory assume that „like their earliest ancestors the archearaneid, all spiders lay a drag line behind them as they move“ (Savory 1960). There exist, of course, more theories on the primitive function of spider silk. From among the rather widely accepted ones, let us recall the egg protection theory (Schuster 1972, Alberti 1973, Forster & Forster 1973, Gabbutt & Aitchinson 1980) and the hypothesis that the silk production and application „have originated in relation to shelter building and burrowing habits of ancestral spiders then still living in a littoral environment“ (Decae 1984).

The 3 pairs of highly functionable spinnerets in araneomorph spiders with very diversified spinning glands of several categories, completed with the cribellum in cribellate spiders, form a basis of a remarkable evolution of webs of spiders of the suborder Araneomorphae. Owing to its chemical composition, spider silk on its own possess outstanding mechanical properties (Goslin et al. 1986). In the thousands of structural modifications of three-dimensional and two-dimensional webs of araneomorphs, the frame threads of the webs are always anchored to the surface of any object by means of attachment discs (Fig. 13), whose silk is produced by glandulae piriformes. The attachment discs of different spider groups are all of the same pattern except in *Pholcus* Walckenaer, 1805 (Schütt 1996). Spiders of the suborder Araneomorphae, except for some special cases (Zodariidae), can form both drag-lines and attachment discs in all postembryonal developmental stages.

Mygalomorphae with reduced ALS are incapable of forming attachment discs. After hatching and leaving the egg-sac, the ALS of the first 3 free instars can possess one spigot and one gland each (Glatz 1972, Hajer 1993, Galiano & Goloboff 1996).

Although the glands cannot be homologized unambiguously with the glandulae ampullaceae of the anterior lateral spinnerets in spiders of the suborder Araneomorphae, the produced fibrous secretion provides to spiderlings contact with the mother nest. In addition, young spiders of the genus *Atypus* soar suspended on silk emitted from spigots of the ALS (Hajer 1993), which is presumably why they geographically are so remarkably widespread (Schwendinger 1990).

However, our insight into the suborder Mygalomorphae is not deep enough to allow any generalization of the above findings.

During their evolution, Atypidae developed another, unique way of attaching silk to the substrate, different from the use of attachment discs, viz. by means of the adhesive secretion discharged through the glandular hairs (Fig. 12). It is reasonable to expect a similar spinning system in spiders of the other families of the suborder Mygalomorphae.

The majority of adult mygalomorphs undoubtedly have reduced ALS. In many of them, however, functional ALS can be expected in the first two to three postembryonic instars, as found, for instance, by Galiano & Goloboff (1996) for the families Actinopodidae and Dipluridae. It is very likely that in one of the main evolutionary line of spiders, see the suborder Mygalomorphae, evolution obviated the ability to form attachment discs. On the other hand, the immense range of webs of so many structural modifications built by spiders of the suborder Araneomorphae could never arise without the attachment disc facility. We must not, of course, forget the third suborder – Mesothelae – which seems to involve the most ancient spiders. The number of four pairs of spinnerets they possess is undoubtedly a plesiomorphic state of this important marker. Like many mygalomorphs, mesotheles live in tubular web burrows.

According to Shear (1994), the webs of mesotheles, from the end of which there run radial triplines, and the webs of mygalomorphs derive from a common precursor, referred to by Shear as a „silk-lined tunnel“. By formulating a spider-web evolution it is necessary to examine what type of silk is produced by the anterior lateral spinnerets and the corresponding glands in young-

est nymphal stages of spiders of the family Mesothelae – and to take the findings into account. Equally important is to ascertain how the web threads are attached to the substrate and to one another, in comparison with the suborders Araneomorphae and Mygalomorphae as discussed above.

REFERENCES

- ALBERTI G. 1973: Ernährungsbiologie und Spinnvermögen der Schnabelmilben (Bdellidae, Trombidiformes). *Ztschr. Morphol. Tiere* **76**: 285–338.
- BROWN R. B. 1945: Spinneret muscle homologies in spiders. *Trans. Connecticut Arts. Sci.* **36**: 245–248.
- CODDINGTON J. A. & LEWIS H. W. 1991: Systematics and evolution of spiders (Araneae). *Annual Rev. Ecol. Syst.* **22**: 565–592.
- DAWYDOFF C. 1949: Développement embryonnaire des arachnides. Pp.: 320–395. In: GRASSÉ P. P. (ed.): *Traité de zoologie, Tome VI*. Paris: Masson, 940 pp.
- DECAE A. E. 1984: A theory on the origin of spiders and the primitive function of spider silk. *J. Arachnol.* **2**: 21–28.
- DOWNES M. E. 1987: A proposal for standartization of the terms used to describe the early development of spiders, based on a study of *Theridion rufipes* Lucas (Araneae, Theridiidae). *Bull. Br. Arachnol. Soc.* **7**: 187.
- FOSTER R. R. & FOSTER L. M. 1973: False Scorpions. Pp.: 53–55. In: *New Zealand Spiders*. Auckland-London: Collins, 384 pp.
- GABBUT P. & AITCHINSON C. W. 1980: The effect of temperature and season on the number of the hibernation chambers built by adult pseudoscorpions. *Proc. 8th Int. Congr. of Arachnol. Vienna*: 57–60.
- GALIANO M. E. & GOLOBOFF P. A. 1996: Postembryonic development of *Actinopus cf. insignis* and *Diplura paraguayensis* (Araneae, Mygalomorphae). *Bull. Br. Arachnol. Soc.* **10**: 121–126.
- GLATZ L. 1972: Der Spinnapparat haplogyner Spinnen (Arachnida, Araneae). *Ztschr. Morphol. Tiere* **72**: 1–26.
- GLATZ L. 1973: Der Spinnapparat der Orthognatha (Arachnida, Araneae). *Ztschr. Morphol. Tiere* **75**: 1–50.
- GOSLIN J. M., DEMONT M. E. & DENNY M. W. 1986: The structure and properties of spider silk. *Endeavour, N. S.* **10**: 37–43.
- HAJER J. 1993: On the spinning apparatus of the spiders of the genus *Atypus* (Araneae, Atypidae). *Boll. Acc. Gioenia Sci. Natur.* **26**: 165–173.
- HAUPT J. & KOVOOR J. 1993: Silk-gland system and silk production in Mesothelae. *Ann. Sci. Natur., Zool., Paris* **13**(14): 35–48.
- KAUTZCH G. 1910: Über die Entwicklung von *Agelena labyrinthica* Clerk. *Zool. Jb. Anat.* **28**: 30–36.
- SAVORY T. H. 1960: Spiders Webs. *Sci. Amer.* **202**: 114–124.
- SAVORY T. H. 1977: *Arachnida*. London, New York, San Francisco: Acad. Press, 47 pp.
- SEYFARTH E. A. 1985: Spider proprioception: receptors, reflexes, and control of locomotion. Pp.: 113–118. In: BARTH F. G. (ed.): *Neurobiology of Arachnids*. Berlin: Springer, 230 pp.
- SCHULTZ J. W. 1987: The origin of the spinning apparatus in spiders. *Biol. Rev.* **62**: 89–113.
- SCHUSTER R. 1972: Spinnvermögen der Tydeiden (Milben). *Die Naturwissenschaften* **59**: 275.
- SCHWENDINGER P. J. 1990: A synopsis of the genus *Atypus* (Araneae, Atypidae). *Zool. Scripta* **19**: 353–386.
- SHEAR W. A. 1994: Untangling the Evolution of the Web. *Amer. Sci.* **82**: 256–266.
- SCHUTT K. 1996: Wie Spinnen ihre Netze befestigen. *Microcosmos* **83**: 274–278.
- WHITEHEAD W. F. & REMPEL J. G. 1959: A study of the musculature of the black widow spider, *Latrodectus mactans* (Fabr.). *Canad. J. Zool.* **37**: 831–870.
- YOSHIKURA M. 1955: Embryological studies on the liphistiid spider *Heptatahela kimurai*. *Kumamoto J. Sci., Ser. B* **1954**(2/3): 73–86.
- YOSHIKURA M. 1958: On the development of a purseweb spider *Atypus karschi*. *Kumamoto J. Sci., Ser. B* **1958**(3): 73–86.

Harvestman (Phalangida) assemblages in the Czech Republic

Leoš KLIMEŠ

Institute of Botany, Section of Plant Ecology, Dukelská 145, CZ–379 82 Třeboň, Czech Republic
e-mail: klimes@butn.cas.cz

Received March 28, 1997; accepted September 16, 1997
Published December 29, 1997

Abstract. A database of harvestman assemblages from the Czech Republic was built up, using both literature and not yet published data. At 117 sites included in the database, nearly 41 000 specimens of 30 species and species aggregates were collected. Only two species of harvestman known from the Czech Republic were not represented in the data. Using TWINSpan, a divisive multivariate classification method, and CCA ordination basic types of harvestman assemblages were delimited and the main environmental factors determining their species composition were identified. Much variation in the data was explained by altitudinal and temperature gradients, another important factor was human impact. The last significant factor was soil moisture which was negatively correlated with human impact. Distribution of individual species along the main environmental factors was compared to literature data and discussed in detail.

Phalangida, communities, multivariate analysis

INTRODUCTION

Harvestmen belong to a prevailingly epigeic group of arachnids colonizing most habitat types in Central Europe. Their abundance reaches high values especially in mesic and wet environments, both in lowlands and in mountains. The species richness of harvestmen is relatively low in Central Europe. For example, the number of species known from the Czech Republic is 32 (Martens 1978, Šilhavý 1981, Klimeš & Bezděčka 1995).

In spite of the long tradition of faunistic research on phalangids in the Czech Republic and former Czechoslovakia (Bárta 1869, Nosek 1900, Šilhavý 1956) the distribution of individual species is so far relatively poorly known. New and unexpected findings have been published recently or are in press (Klimeš & Bezděčka 1995, Bezděčka 1996, Klimeš & Roušar in press, Roušar in prep.). Moreover, some species are spreading in recent times, such as *Opilio canestrinii* (Klimeš 1995, Klimeš & Roušar in press) so that the overall picture is still very incomplete. Similarly, our knowledge of the biology of individual species and their participation in harvestman assemblages is also poor. So far, some data have been published on the species composition of harvestmen collected in forests (Obrtel 1976, Šmaha 1983, 1984, Klimeš & Špičáková 1984, Křístek 1985, 1991, Sechterová-Špičáková 1988, Sechterová 1990), grasslands (Šmaha 1983, 1984, Klimeš & Sechterová 1989) and ruderalized habitats (Sechterová 1987, Sechterová-Špičáková 1989), and on dynamics of individual species throughout the year (Borek 1958, Obrtel 1976, Klimeš & Špičáková 1984, Klimeš 1990). However, there has been no attempt to summarize the data on harvestman assemblages in the Czech Republic.

The aim of this paper is 1) to put together all material on harvestman assemblages from the Czech Republic available both from literature and from unpublished data of the author and to delimit individual types of harvestman assemblages using their species composition, 2) to iden-

tify the main environmental gradients along which the assemblages are differentiated and 3) to find out the position of individual species along the main environmental gradients.

MATERIAL AND METHODS

The material used in this study includes all literature sources on harvestman assemblages sampled in the Czech Republic and the author's unpublished data (see Fig. 1 and Appendix). Most data sets included in the database were based on year-round sampling, mostly by pitfall traps. In several cases two- or three-year data were at disposal. Data based on short-term sampling were used only when most species had their maximum abundance period during the collecting period, so that longer periods of collecting would hardly significantly change the participation of individual species in the whole material. This was the case of harvestman assemblages collected on walls in towns. These were the only samples collected by hand. The samples which included a few individuals only were excluded from the database.

Leiobunum rupestre was lumped with *L. tisciae* to *L. rupestre* agg., as most specimens belonging to these two taxa were small juveniles in which species identification was impossible. The two species are geographical vicariants (Šilhavý 1981) with approximately the same environmental demands. Reversely, *Nemastoma lugubre* was treated separately from its melanistic variant even if the taxonomic value of the latter type is low (Kratochvíl 1934, Bartoš 1949, Martens 1978). However, there is a clear difference in distribution along the altitudinal gradient between the two varieties. Nomenclature of harvestman species follows Martens (1978), except *Zachaeus crista* (Crawford 1992).

The data in the database were analysed using multivariate approaches. For ordination of stands and species canonical correspondence analysis was used (ter Braak 1987, Jongman et al. 1995) in which $\ln(x+1)$ transformation of species abundance was applied to suppress strongly dominating species. Classification of the material was performed using Two Way Indicator SPecies ANalysis (TWINSPAN – Hill 1979).

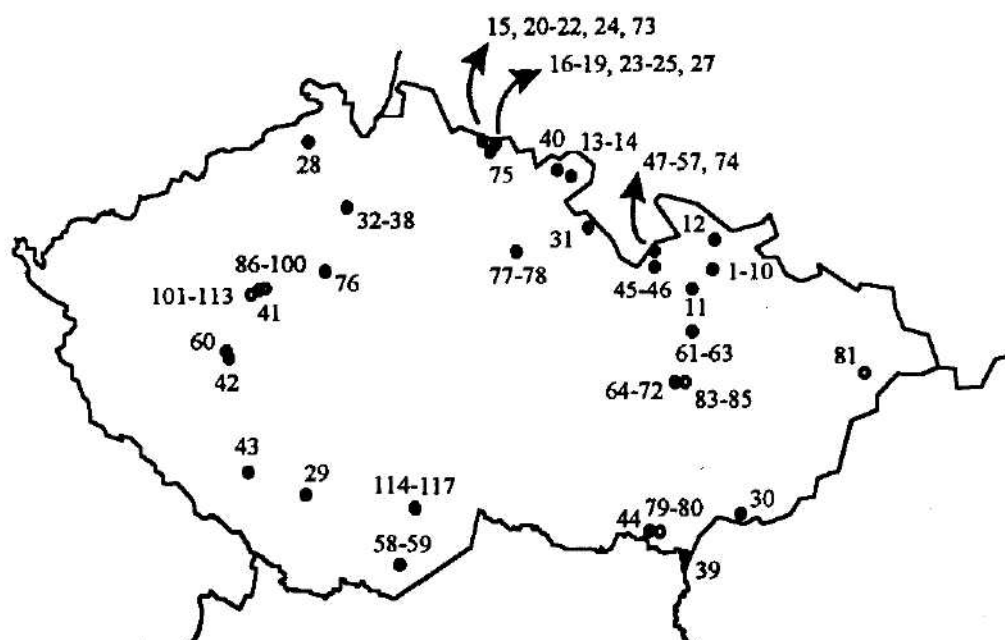


Fig. 1. Location of 117 sampling sites in the Czech Republic. Full circle – unpublished material, open circle – data from literature. For a complete list of sites see Appendix.

RESULTS

The database of harvestman assemblages included 30 species collected at 117 sites (Tables 1–2). Altogether 40 838 individuals were collected. *Oligolophus tridens* was the most frequent species, found at 75.5% of sites, followed by *Lacinius ephippiatus* and *Mitopus morio*. Considering the number of captured individuals *Oligolophus tridens* with more than 11 000 individuals was the most abundant species. *Mitopus morio* (7034) and *Platybunus bucephalus* (6405 individuals) occupied second and third positions, respectively.

The variation explained by the first two axes of CCA was 38 and 21%, respectively. Using several environmental factors as explaining variables six habitat types were distinguished in the CCA biplot (Fig. 2). Sites in alpine and upper mountain vegetation belts represented the first group. A high altitude and cold climate characterize the environment of these sites situated in upper vegetation belts (Fig. 2). Within the cluster a small, clearly separated subgroup of sites

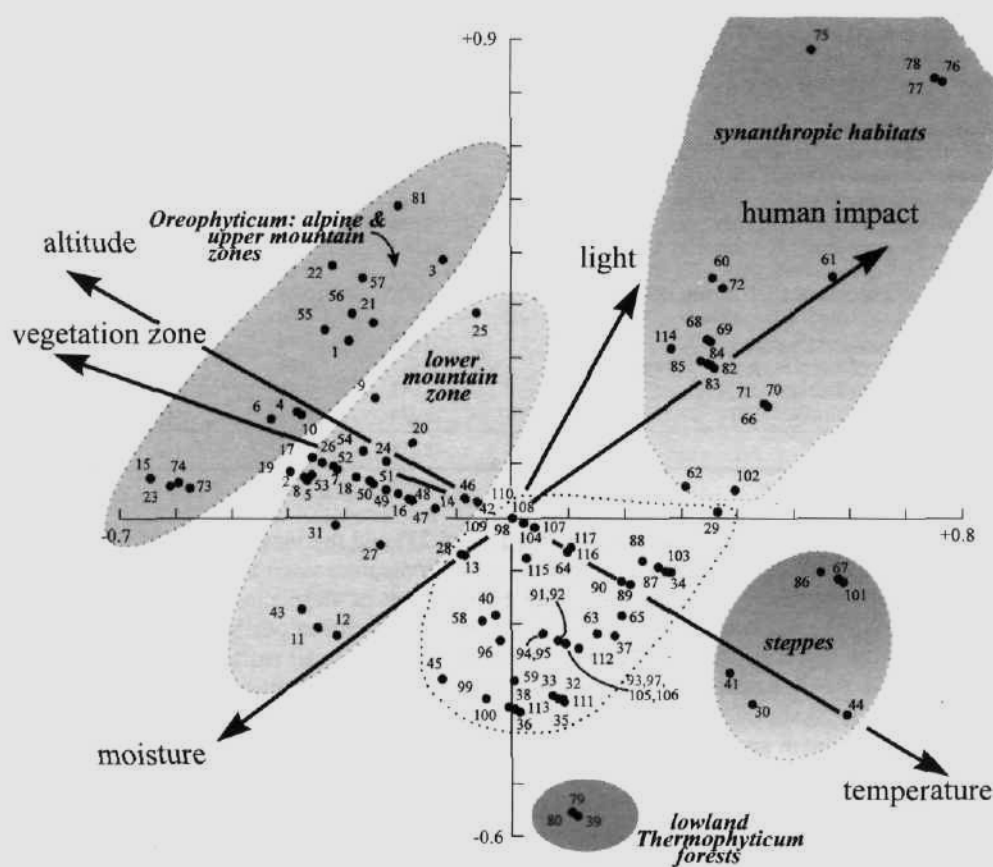


Fig. 2. CCA ordination of 117 sampling sites based on ln transformed abundance data. Individual clusters of sites from the same habitat type are in ellipses and envelopes, shading indicates an environmental gradient.

Table 1. List of species, number and percentage of individuals, and number and percentage of sites (n = 117) at which particular species were collected

No.	Name	No. of individuals	% of individuals	No. of localities	% of localities
1	<i>Astrobum laevipes</i> (Canestrini, 1872)	440	1.08	4	3.6
2	<i>Egaenus convexus</i> (C. L. Koch, 1835)	12	0.03	1	0.9
3	<i>Gyas titanus</i> Simon, 1879	3	0.01	2	1.8
4	<i>Ischyropsalis hellwigi</i> (Panzer, 1794)	39	0.10	13	11.8
5	<i>Ischyropsalis manicata</i> L. Koch, 1865	180	0.44	1	0.9
6	<i>Lacinius dentiger</i> (C. L. Koch, 1848)	1	0.00	1	0.9
7	<i>Lacinius ephippiatus</i> (C. L. Koch, 1835)	4845	11.86	70	63.6
8	<i>Lacinius horridus</i> (Panzer, 1794)	520	1.27	24	21.8
9	<i>Leiobunum blackwalli</i> Meade, 1861	4	0.01	1	0.9
10	<i>Leiobunum limbatum</i> L. Koch, 1861	33	0.08	3	2.7
11	<i>Leiobunum rotundum</i> (Latreille, 1798)	63	0.15	10	9.1
12	<i>Leiobunum rupestre</i> (Herbst, 1799) agg.	51	0.12	7	6.4
13	<i>Lophopilio palpinalis</i> (Herbst, 1799)	2507	6.14	54	49.1
14	<i>Mitopus morio</i> (Fabricius, 1799)	7034	17.22	69	62.7
15	<i>Mitostoma chrysomelas</i> (Hermann, 1804)	228	0.56	22	20.0
16	<i>Nemastoma lugubre</i> (O. F. Müller, 1776)	2179	5.34	68	61.8
17	<i>Nemastoma lugubre</i> (O. F. Müller, 1776), melanistic variant	1127	2.76	22	20.0
18	<i>Nemastoma triste</i> (C. L. Koch, 1835)	37	0.09	4	3.6
19	<i>Oligolophus tridens</i> (C. Koch, 1836)	11012	26.97	83	75.5
20	<i>Opilio canestrinii</i> (Thoroll, 1876)	30	0.07	2	1.8
21	<i>Opilio parietinus</i> (De Geer, 1778)	20	0.05	8	7.3
22	<i>Opilio saxatilis</i> C. L. Koch, 1839	56	0.14	9	8.2
23	<i>Paranemastoma quadripunctatum</i> (Perty, 1833)	1865	4.57	58	52.7
24	<i>Phalangium opilio</i> Linné, 1761	360	0.88	23	20.9
25	<i>Platybunus bucephalus</i> (C. L. Koch, 1835)	6405	15.68	60	54.5
26	<i>Platybunus pallidus</i> Šilhavý, 1938	1	0.00	1	0.9
27	<i>Rilaena triangularis</i> (Herbst, 1799)	1412	3.46	53	48.2
28	<i>Trogulus nepaeformis</i> (Scopoli, 1763) agg.	117	0.29	18	16.4
29	<i>Trogulus tricarinatus</i> (Linné, 1767)	183	0.45	33	30.0
30	<i>Zachaeus crista</i> (Brullé, 1832)	74	0.18	1	0.9
Totals		40838	100.00		

can be discriminated. It includes wetlands (sites 15 and 23) and the inner environment of stony debris (sites 73 and 74), characterized by species-poor harvestman assemblages. Another cluster included sites of the lower mountain zone. The environment of these sites is less extreme than that of the previous cluster in all respects. Similarly to the first cluster peatbogs (sites 11 and 12, together with the forested National Reserve of Boubín) form a small isolated subgroup within the cluster. The third cluster included sites found in the middle mountain (upper hill country zone according to Skalický 1988) where the optimum moisture, humidity and temperature for most forest harvestmen species is found. Steppe sites formed a clearly separated cluster at the other extreme of the altitude/temperature gradient. A small group of sites of flooded lowland forests in the Thermophyticum (sensu Skalický 1988) was clearly isolated from the other sites. The last cluster lying outside the main environmental gradient included sites with a strong human impact. This cluster was rather large and included the whole range between synanthropized meadows, field margins and arable land up to man-made habitats, such as walls in cities. This gradient was negatively correlated with soil moisture and partly positively correlated with increasing temperature and light intensity (Fig. 2).

towns, and arable land. They were found also in man-made environments, such as on walls in towns, where *Opilio canestrinii*, *Leiobunum limbatum* and *L. blackwalli* dominated.

Using TWINSpan a simple classification of harvestman assemblages was obtained. Species were grouped into six blocks with a high species-to-species correlation. The species groups largely overlapped with those obtained from CCA ordination (Table 2). The first block (*Mitopus morio* to *Nemastoma lugubre*, melanistic variant: the upper left box in Table 2) included species with a high abundance in mountains. Their abundance and frequency decreased towards lower elevations. Some of the species with a wider ecological amplitude were occasionally also found in lowlands (e. g., *Mitopus morio* and *Nemastoma triste*). The second species group included *Paranemastoma quadripunctatum*, *Lacinius ephippiatus* and *Lophopilio palpinalis*. All of them possess a relatively broad ecological amplitude and were collected with a high frequency at many sites. However, their optimum was clearly at medium altitudes and their frequency decreased both towards higher altitudes and lowlands. The third species group included *Nemastoma lugubre* and *Oligolophus tridens*. Their frequency and abundance was high everywhere, except for man-made habitats. Their presence was of little indicative value. *Astrobus laevipes*, *Trogulus nepaeformis* and *T. tricarinatus* formed the next species group which was missing in mountain forests and above timberline. The frequency of these species was relatively low. The last but one group included five species, *Egaenus convexus*, *Lacinius horridus*, *Opilio parietinus*, *Phalangium opilio* and *Zachaeus crista*. They are typical of open, dry habitats and woods in dry regions. The assignment of *Lacinius dentiger* to this group seems to be uncertain. The last species group included species which reached the highest frequency in man-made habitats. Some of these species can be found also under natural conditions (*Leiobunum blackwalli*, *L. rotundum*, *Opilio saxatilis*). The last species, *Opilio canestrinii*, is, as far as known, limited in the Czech Republic to man-made habitats.

DISCUSSION

Out of the 32 species known from the Czech Republic only two were missing in the database: *Nelima semproni* Szalay, 1951 is a thermophilous species known from a small area in southern Moravia (Šilhavý 1971a) recently discovered in the neighbourhood of Louny (Roušar 1997). The other species not represented in the database was *Paranemastoma kochi* (Nowicki, 1870). This is a Carpathian element reaching its westernmost localities in the Moravskoslezské Beskydy Mts. (Šilhavý 1972). Unfortunately, two species were collected as a single individual and three more species were found on one locality only so that for these species the analysis presented above should be considered as preliminary. Further data are needed to complete the picture of their associations with other species and their environmental demands. On the other hand, 16 species were found at 10 and more sites, so that enough data were at our disposal to define their participation in harvestman assemblages.

The 117 sites did not cover the area of the Czech Republic equally. There were no data from the westernmost part of the Czech Republic, nor from a large area between Praha and SE Moravia. On the other hand, extensive material from the Krkonoše Mts. and the Jeseníky Mts. has been collected. Dry habitats were underrepresented in the database as a result of difficulties with the utilisation of pitfall traps at sites with shallow soils and direct sunshine. Considering individual species, long-legged *Leiobunum* species are possibly underrepresented in the material similarly as *Lacinius dentiger*, a species abundant in shrub and tree layers. However, all these species were missing or rare also as juveniles in spite of the fact that young individuals of all harvestmen are living at the soil surface because of their inability to regulate their internal water

regime in shrub and tree layers where air humidity is often too low. Therefore, I believe that the material available for the analysis quite well represented harvestman assemblages of the Czech Republic.

The analysis presented in this paper indicated that most harvestmen species have relatively broad ecological amplitudes along the main environmental gradients. However, there were several species assemblages which indicated their habitats quite well, much better than individual species did. In the upper belts of mountains usually relatively species-poor assemblages were found. There were also a few species usually missing at lower elevations, such as *Nemastoma triste*, *Ischyropsalis hellwigi*, *I. manicata* and *Platybunus pallidus*. They are characterized by a scattered distribution over the whole country and relatively low population density. Alpine derivatives of the abovementioned mountain forest fauna are species-poor with no species limited to this belt. There was no difference between species assemblages colonizing the inner environment of stony debris and those occurring in alpine peatbogs. Both of them were species-poor derivatives of the mountain forest species assemblages. This contrasts to a specific spider fauna of stony debris which include several relict species, in Central Europe limited to this environment (Růžička et al. 1989, Růžička & Zacharda 1994, Růžička et al. 1995). In contrast, dry environments in lowlands have a distinct species composition of harvestmen with several species limited to this environment (*Zachaeus crista*, *Astrobus laevipes*, *Egaenus convexus*, *Lacinius horridus*). The third extreme is represented by synanthropic habitats. All harvestmen species in this environment are annual, with overwintering eggs and with adults in the late summer up to the end of the year. They are long-legged and belong to three independent evolutionary units – the subfamilies Leiobuninae, Opilioninae and Phalangiinae. All of them are evolutionary young and derived lineages (Martens 1978).

The results of CCA ordination of the species suggesting environmental demands and distributional limits caused by the local environment corresponded well to the literature data on individual species (summarized by Martens 1978, for example). Still, there are a few species which require some comments: *Leiobunum limbatum* was found exclusively on walls in cities. This is a species spreading in recent times up to the foot of the mountains (e. g., Pec pod Sněžkou, 700 m a. s. l.) where it reaches very high abundance. So far it has been reported from a few localities from the Czech Republic (Radnice near Plzeň – Martens 1978, Netín near Velké Meziříčí – Kratochvíl 1934, Bílé Karpaty – Bezděčka 1996, the valley of Bezručovo údolí near Chomutov, Hradec Králové, Třeboň, Praha, Pec pod Sněžkou, Trutnov – Klimeš & Roušar in press). Most of them, if not all, are synanthropic. Under natural conditions the species is usually found on rocks in forests of various types (Martens 1978). Its distribution out of towns needs more attention in the Czech Republic. Similarly, the habitat requirements of *L. blackwalli* are poorly known. In Germany this species is less synanthropic than *L. rotundum* (Martens 1978). However, the data from the Czech Republic are too scarce to make any conclusion about habitat preference of this species (Šilhavý 1956, 1971b, Klimeš & Roušar in press). The third synanthropic species in the data set is *Opilio canestrinii*. In the Czech Republic it has been discovered in 1994 and a number of localities has been found since, both in Bohemia and Moravia, up to the feet of mountains (Klimeš & Roušar in press). So far no occurrence out of towns and villages has been recorded even if its high abundance in gardens and reports from Germany (Bliss 1982, Bachmann & Schaefer 1983, Malten 1991) indicate that its spreading to natural habitats can be expected in the near future.

Egaenus convexus and *Zachaeus crista* are species with most localities in the Balkan Peninsula (Starega 1976, Martens 1978). In the Bílé Karpaty Mts. they reach their north-western distributional limit. Their position in the CCA ordination in Fig. 3 is therefore strongly affected

by their distributional limits in the Czech Republic which seems to be, at least partly, historically determined, as they are missing in other warm and dry regions of South Moravia. *Astrobus laevipes* is a thermophilous species and SE European zoogeographical element. In contrast to the two species discussed above it also spread to Bohemia, and along the Labe River to Germany, north up to Halle/Saale. Besides, there are a few isolated localities in Bayern, Hessen and Baden Württemberg (Baumann et al. 1992). Recently a wider distribution in Bohemia has been discovered (Klimeš & Roušar in press). Its distribution along the moisture gradient is wider than those of *Egaenus convexus* and *Zachaeus crista*; *Astrobus laevipes* has been recorded both at xerothermic localities and in wetlands.

Platybunus pallidus and *Ischyropsalis manicata* are two mountain species with a Carpathian distribution. The first species was represented in the data set by occurrence at a single locality in the Moravskoslezské Beskydy Mts., in spite of the fact that Šilhavý (1947) found it quite common in the Jeseníky Mts. from where I had extensive material at my disposal. *Ischyropsalis manicata* was collected in the Czech Republic only in the easternmost part of North Moravia by Máca (Šilhavý 1973) and Sechterová-Špičáková (1988). In the Carpathians it is a forest species of the mountain belt preferring colder localities with a high air humidity (Avram 1964). Surprisingly, its locality in the Moravskoslezské Beskydy is quite open and close to the top of a mountain. However, stony debris partly covered by soil and shrubby vegetation offer a suitable micro-environment for this species. It occurs there together with *I. hellwigi* (subsp. *hellwigi*), a Central European species scattered over hills and mountains in the whole country and occurring at all localities known to me at low abundance.

Most of the species occupying the central part of the CCA diagram (Fig. 3) colonize a wide range of environments except for several mountain taxa, such as *Nemastoma triste*, *Gys titanus*, *Mitostoma chrysomelas* and melanistic variant of *Nemastoma lugubre* which strongly prefer environments where cold temperature and high air moisture prevail during the whole year and which are not affected by humans. This kind of habitats sometimes also occurs at lower elevations where these species may survive as relict populations.

Acknowledgements

The presented paper was largely based on harvestmen collected and in most cases also extracted from the mess of epigeic arthropods from pitfall traps by L. Beran, I. Chvátalová, J. Chytil, V. Kavalcová, B. Mocek, V. Růžička, J. Špišek and K. Tajovský. I thank to all of them for putting their material at my disposal. My thanks are to J. W. Jongepier for linguistic help and to J. Gruber for valuable comments.

REFERENCES

- AVRAM S. 1964: Observations sur la variabilité de l'espèce *Ischyropsalis dacica* Roewer des Grottes de Roumanie (Opilions, Palpatores, *Ischyropsalis*). *Rev. Roum. Biol.-Zool.* 9: 245–256.
- BACHMANN E. & SCHAEFER M. 1983: The Opilionid fauna of a beach wood and dry grassland on limestone (Arachnida: Opilionida). *Verh. Naturwiss. Ver. Hamburg (N. F.)* 26: 141–149.
- BÁRTA E. 1869: Verzeichnis der Spinnen des nördlichen Böhmen. *Arch. Naturwiss. Landesdurchforsch. Böhmen* 1: 133–140.
- BARTOŠ E. 1949: [Harvestmen from the *Nemastoma lugubre* group in Czechoslovakia]. *Entomol. Listy* 12: 57–61 (in Czech).
- BAUMANN T., BLICK T., FOCKLER F. & SCHLEUTER M. 1992: Erstnachweis von *Astrobus laevipes* und *Nemastoma dentigerum* in Bayern (Opiliones: Phalangidae, Nemastomatidae). *Arachnol. Mitt.* 3: 58–61.
- BEZDĚČKA P. 1996: [First contribution the harvestmen in SE Moravia]. *Sborn. Přírodověd. Klubu v Uherském Hradišti* 1: 52–55 (in Czech).
- BLISS P. 1982: Die Weberknechte (Arachnida, Opiliones) der Naturschutzgebiete Grosser und Kleiner Hakei und angrenzenden Waldgebiete. *Hercynia (N. F.)* 19: 85–96.

- BOREK V. 1958: Zur Phenologie unsere Weberknechte (Opiliones). *Čas. Čs. Společ. Entomol.* 55: 297–298 (in Czech, Germ. abstr.).
- BUCHAR J. 1982: Publication of faunistic data from Czechoslovakia. *Věst. Čs. Společ. Zool.* 46: 317–318 (in Czech, Engl. abstr.).
- CRAWFORD R. L. 1992: Catalogue of the genera and type species of the harvestman superfamily Phalangioidea (Arachnida). *Burke Mus. Contrib. Anthropol. Natur. Hist.* 8: 1–60.
- HILL M. O. 1979: *TWINSPAN – A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of individuals and attributes*. Ithaca, N. Y.: Cornell University, 90 pp.
- JONGMAN R. H., TER BRAAK C. J. F. & VAN TONGEREN O. F. R. 1995: *Data analysis in community and landscape ecology*. Wageningen: Pudoc, New ed., 299 pp.
- KLIMES L. 1990: [The effect of flooding on life cycle of *Rilaena triangularis* (Herbst) (Opiliones)]. *Sborn. Jihočes. Muz. Čes. Budějovice, Přír. Vědy* 30: 37–45 (in Czech).
- KLIMES L. 1995: [A new species of harvestmen in the Czech Republic]. *Živa* 43: 76–77 (in Czech).
- KLIMES L. & BEZDĚČKA P. 1995: *Egagnus convexus*: a new harvestman from the Czech Republic. *Arachnol. Mitt.* 10: 32–33.
- KLIMES L. & ROUŠAR A. in press: Remarkable harvestmen from the Czech Republic. *Arachnol. Mitt.* 13.
- KLIMES L. & SECHTEROVÁ E. 1989: Epigaeic arthropods across an arable land and grassland interface. *Acta Entomol. Bohemoslov.* 86: 459–475.
- KLIMES L. & ŠPIČÁKOVÁ E. 1984: [A contribution to the knowledge of dynamics of arachnids across a forest-meadow ecotone]. *Acta Univ. Palackianae Olomucensis Fac. Rer. Natur.* 81: 167–190 (in Czech).
- KRATOCHVÍL J. 1934: [Harvestmen (Opiliones) of Czechoslovakia]. *Pr. Morav. Přírodověd. Společ.* 9(5): 1–35 (in Czech).
- KŘISTEK J. 1985: Structure of insects, spiders and harvestmen of a floodplain forest. Pp.: 327–356. In: PENKA M., VYSKOT M., KLIMO E. & VAŠÍČEK F. (eds.): *Floodplain forest ecosystem. I. Before water management*. Amsterdam: Elsevier-Academia, 468 pp.
- KŘISTEK J. 1991: Selected groups of insects and harvestmen. Pp.: 451–468. In: PENKA M., VYSKOT M., KLIMO E. & VAŠÍČEK F. (eds.): *Floodplain forest ecosystem. II. After water management measures*. Amsterdam: Elsevier-Academia, 632 pp.
- MALTEN A. 1991: Über *Opilio canestrinii*. *Arachnol. Mitt.* 1: 81–88.
- MARTENS J. 1978: *Spinnentiere, Arachnida: Weberknechte, Opiliones. Die Tierwelt Deutschlands. Vol. 64*. Jena: Gustav Fischer Verlag, 464 pp.
- OBŘTEL R. 1976: Soil surface harvestmen (Opiliones) in a lowland forest. *Acta Sci. Natur. Brno* 10(12): 1–34.
- NOSEK A. 1900: [An identification key of the Czech harvestmen (Opiliones)]. *Vesmír* 29: 29–30, 39–40, 62–63, 99–100 (in Czech).
- ROUŠAR A., 1997: [The harvestman *Nelima semproni* – a new species for the Czech Republic]. *Acta Univ. Purkynianae, Sect. Biol.* 5: in press (in Czech).
- RŮŽICKÁ V., BOHÁČ J., SYROVÁTKA O. & KLIMES L. 1989: [Invertebrates of stony debris in north Bohemia (Araneae, Opiliones, Coleoptera, Diptera)]. *Sborn. Severočes. Muz., Přír. Vědy* 17: 25–36 (in Czech).
- RŮŽICKÁ V., HAJER J. & ZACHARDA M. 1995: Arachnid population patterns in underground cavities of a stony debris field (Araneae, Opiliones, Pseudoscorpionida, Acari: Prostigmata, Rhagidiidae). *Pedobiologia* 39: 42–51.
- RŮŽICKÁ V. & ZACHARDA M. 1994: Arthropods of stony debris in the Krkonoše Mountains, Czech Republic. *Arct. Alpine Res.* 26: 332–338.
- SECHTEROVÁ E. 1987: [Spiders (Araneida) and harvestmen (Opiliones) in the groves]. *Zpr. Kraj. Vlastivěd. Muzea v Olomouci* 247: 1–20 (in Czech).
- SECHTEROVÁ-ŠPIČÁKOVÁ E. 1988: Communities of spiders (Araneida) and harvestmen (Opiliones) in State Nature Reserve Smrk in the Beskydy mountains affected by immissions. *Acta Univ. Palackianae Olomucensis, Fac. Rer. Natur., Biol.* 28: 163–178.
- SECHTEROVÁ-ŠPIČÁKOVÁ E. 1989: Spiders (Araneida) and harvestmen (Opiliones) in the groves. II. *Acta Univ. Palackianae Olomucensis, Fac. Rer. Natur., Biol.* 29: 165–189.
- SECHTEROVÁ E. 1990: [Activity and seasonal dynamics of epigaeic spiders and harvestmen in forest biocoenoses of the Beskydy Mts. (Araneae; Opiliones)]. *Acta Univ. Palackianae Olomucensis, Fac. Rer. Natur., Biol.* 30: 219–232 (in Czech).
- SKALICKÝ V. 1988: [Regional phytogeographical division]. Pp.: 103–121. In: HEJNÝ S. & SLAVÍK B. (eds.): *Květena České socialistické republiky, Vol. I*. Praha: Academia, 560 pp (in Czech).
- STAREGA W. 1976: Die Weberknechte (Opiliones, excl. Sironidae) Bulgariens. *Ann. Zool.* 33: 287–433.
- ŠILHAVÝ V. 1938: [Harvestmen of the Jeseníky Mts.]. *Sborn. Klubu Přírodověd. v Brně* 20: 68–74 (in Czech).
- ŠILHAVÝ V. 1947: [Harvestmen of the Jeseníky Mts.]. *Entomol. Listy* 10: 16–19 (in Czech).
- ŠILHAVÝ V. 1971a: [First records of the harvestman *Nelima semproni* Szalay from Czechoslovakia]. *Sborn. Přírodověd. Klubu Západo-morav. Muz. v Třebíči* 8: 107–110 (in Czech).
- ŠILHAVÝ V. 1971b: [Harvestmen – Opiliones]. Pp.: 33–49. In: DANIEL M. & ČERNÝ V. (eds.): *Klíč zvířeny ČSSR, Vol. 4*. Praha: Academia (in Czech).

- ŠILHAVÝ V. 1972: [The second contribution towards knowledge of harvestmen in Czechoslovakia (Opiliones)], *Zpr. Čs. Společ. Entomol.* 8: 93–96 (in Czech).
- ŠILHAVÝ V. 1973: [First record of the harvestman *Ischyropsalis manicata* L. Koch in Moravia], *Sborn. Přírodověd. Klubu Západo-morav. Muz. v Třebíči* 9: 83–84 (in Czech).
- ŠILHAVÝ V. 1981: Occurrence of *Leiobunum glabrum* in Czechoslovakia (Arach., Opiliones), *Věst. Čs. Společ. Zool.* 45: 204–208.
- ŠMAHA J. 1983: [A contribution towards harvestmen (Opiliones) in the Křivoklátská Region], *Bohemia Centr.* 12: 115–127 (in Czech).
- ŠMAHA J. 1984: [The record of *Nemastoma triste* (C. L.K., 1835) and other findings of harvestmen /Opiliones/ in the Natural Reserve of Týřov], *Bohemia Centr.* 13: 291–295 (in Czech).
- TER BRAAK C. J. F. 1987: *CANOCO – a FORTRAN program for canonical community ordination by [partial] [detrended] [canonical] correspondence analysis, principal components analysis and redundancy analysis (version 2.1)*. Wageningen: Agricultural Mathematics Group, 95 pp.
- TER BRAAK C. J. F. 1988: CANOCO – an extension of DECORANA to analyze species-environment relationships. *Vegetatio* 39: 43–51.

APPENDIX

Survey of material. Quadrangles of the square grid according to Buchar (1982) are given.

No.	Locality	Quadrangle	Collector & Year / Reference
1	Jeseníky, bottom of the Velká kotlina cirque	5969	leg. V. Kavalcová, 1995
2	Jeseníky, Velká kotlina cirque, Daphno-Accretum	5969	leg. Tajovský, 1994–1995
3	Jeseníky, Velká kotlina cirque, Thesio-Nardetum	5969	leg. Tajovský, 1994–1995
4	Jeseníky, Velká kotlina cirque, Festuco-Vaccinietum	5969	leg. Tajovský, 1994–1995
5	Jeseníky, Velká kotlina cirque, Poo-Deschampsietum	5969	leg. Tajovský, 1994–1995
6	Jeseníky, Velká kotlina cirque, Adenostyletum alliariae	5969	leg. Tajovský, 1994–1995
7	Jeseníky, Velká kotlina cirque, Fagetum	5969	leg. Tajovský, 1994–1995
8	Jeseníky, Velká kotlina cirque, Laserpitio-Dactylidetum	5969	leg. Tajovský, 1994–1995
9	Jeseníky, Velká kotlina cirque, Calamagrostio-Piceetum	5969	leg. Tajovský, 1994–1995
10	Jeseníky, Velká kotlina cirque, Festuco-Vaccinietum	5969	leg. Tajovský, 1994–1995
11	Jeseníky, Skřítek peatbog	6068	leg. I. Chvátilová, 1990–1991
12	Jeseníky, Rejviz peatbog	5769	leg. V. Kavalcová, 1995
13	Broumovsko, Kovářova rokle	5463	leg. J. Spišek, 1995
14	Broumovsko, Ostaš and Hejda	5463	leg. J. Spišek, 1995
15	Krkonoše, Úpská rašelina peatbog	5260	leg. Tajovský, 1989–1991
16	Krkonoše, Trídolí	5259	leg. Tajovský, 1989–1991
17	Krkonoše, Navorská jáma	5259	leg. Tajovský, 1989–1991
18	Krkonoše, V bažinkách	5259	leg. Tajovský, 1989–1991
19	Krkonoše, Schusterova zahrádka	5259	leg. Tajovský, 1989–1991
20	Krkonoše, Přední Rennerovky, clearing	5260	leg. Tajovský, 1989–1991
21	Krkonoše, Zadní Rennerovky	5260	leg. Tajovský, 1989–1991
22	Krkonoše, Studniční hora	5260	leg. Tajovský, 1989–1991
23	Krkonoše, Pančavská louka peatbog	5259	leg. Tajovský, 1989–1991
24	Krkonoše, Dvoračky	5259	leg. Tajovský, 1989–1991
25	Krkonoše, Dvoračky, the plots treated by Roundup	5259	leg. Tajovský, 1989–1991
26	Krkonoše, Přední Rennerovky – Kostlivčí les	5260	leg. Tajovský, 1989–1991
27	Krkonoše, Pod bažinkami	5259	leg. Tajovský, 1989–1991
28	N Bohemia, Kamence	5252	leg. V. Růžička, 1993–1994
29	S Bohemia, Dlouhá Ves (incomplete material)	6950	leg. K. Tajovský, 1987–1988
30	Bílé Karpaty Mts., National Reserve of Čertoryje	7170	leg. L. Klimeš, 1994
31	Orlické hory Mts., National Reserve of Bukáčka	5664	leg. B. Mocek
32	Kokořínsko, Kokořínský důl, Harasov, <i>Carex</i> wetland at the pond of Harasov	5553	leg. L. Beran, 1995–1996
33	Kokořínsko, springs of the Pšovka River, <i>Carex</i> wetland	5553	leg. L. Beran, 1995–1996
34	Kokořínsko, Ronov, scree, xerothermic SW slopes and a sparse forest	5553	leg. L. Beran, 1995–1996

No. Locality	Quadrangle	Collector & Year / Reference
35 Kokořínsko, wetlands near Liběchovka: <i>Carex</i> wetland at the Ruprechtice village	5553	leg. L. Beran, 1995–1996
36 Kokořínsko, wetlands near Liběchovka: spring alder carr near Vrabecov	5553	leg. L. Beran, 1995–1996
37 Kokořínsko, Ronov, sparse scree forest and margin of a scree	5553	leg. L. Beran, 1995–1996
38 Kokořínsko, Kokořínský důl, Vojtěchov, alder carr at the Stříbrník fishpond	5553	leg. L. Beran, 1995–1996
39 S Moravia, National Reserve of Ranšpurk	7367	leg. J. Chytil, 1993
40 E Bohemia, the National Reserve of Teplicko-Adršpašské skály	5462	leg. V. Růžička, 1991–1993
41 Křivoklátský Landscape Protected Area, Vělká Pleš, Vůznice	5949	leg. V. Růžička, 1993–1994
42 Brdy Mts., Strašice, Reserva	6248	leg. L. Klimeš, 1983
43 Šumava Mts., National Nature Reserve of Boubín	7048	leg. V. Růžička, 1989
44 Pálava Protected Landscape Area, Nature Reserve of Slanisko	7166	leg. J. Chytil, 1993
45 Králický Sněžník, valley of the Morava River, 590 m a. s. l.	5866	leg. L. Klimeš, 1985
46 Králický Sněžník, valley of the Morava River, 650 m a. s. l.	5866	leg. L. Klimeš, 1985
47 Králický Sněžník, valley of the Morava River, 720 m a. s. l.	5866	leg. L. Klimeš, 1985
48 Králický Sněžník, valley of the Morava River, 825 m a. s. l.	5867	leg. L. Klimeš, 1985
49 Králický Sněžník, valley of the Morava River, 880 m a. s. l.	5867	leg. L. Klimeš, 1985
50 Králický Sněžník, valley of the Morava River, 930 m a. s. l.	5867	leg. L. Klimeš, 1985
51 Králický Sněžník, valley of the Morava River, 990 m a. s. l.	5867	leg. L. Klimeš, 1985
52 Králický Sněžník, valley of the Morava River, 1060 m a. s. l.	5867	leg. L. Klimeš, 1985
53 Králický Sněžník, S slope of Králický Sněžník, 1150 m a. s. l.	5867	leg. L. Klimeš, 1985
54 Králický Sněžník, S slope of Králický Sněžník, 1220 m a. s. l.	5867	leg. L. Klimeš, 1985
55 Králický Sněžník, S slope of Králický Sněžník, 1300 m a. s. l.	5867	leg. L. Klimeš, 1985
56 Králický Sněžník, S slope of Králický Sněžník, 1375 m a. s. l.	5867	leg. L. Klimeš, 1985
57 Králický Sněžník, S slope of Králický Sněžník, 1420 m a. s. l.	5767	leg. L. Klimeš, 1985
58 Stropnice: peatbog	7254	leg. V. Růžička, 1989
59 Stropnice: meadows	7254	leg. V. Růžička, 1989
60 Strašice: woods and meadow patches surrounded by arable land	6248	leg. L. Klimeš, 1983
61 Pomoraví Protected Landscape Area, Mladeč, arable land within a clearing	6268	Klimeš & Špičáková 1984
62 Pomoraví Protected Landscape Area, Mladeč, ecotone between arable land and a flooded lowland forest	6268	Klimeš & Špičáková 1984
63 Pomoraví Protected Landscape Area, Mladeč, flooded lowland forest	6268	Klimeš & Špičáková 1984
64 Čubernice Nature Reserve, pitfall traps 1, 2 and 5	6568	leg. Klimeš & Špičáková, 1982
65 Čubernice Nature Reserve, pitfall traps 3 and 4	6568	leg. Klimeš & Špičáková, 1982
66 Čubernice Nature Reserve, pitfall traps 7 and B	6568	leg. Klimeš & Špičáková, 1982
67 Čubernice Nature Reserve, pitfall traps 8 to 14, 16, A and F	6568	leg. Klimeš & Špičáková, 1982
68 Čubernice Nature Reserve, pitfall trap 19	6568	leg. Klimeš & Špičáková, 1982
69 Čubernice Nature Reserve, pitfall trap S	6568	leg. Klimeš & Špičáková, 1982
70 Čubernice Nature Reserve, pitfall trap 6	6568	leg. Klimeš & Špičáková, 1982
71 Čubernice Nature Reserve, pitfall trap 15	6568	leg. Klimeš & Špičáková, 1982
72 Čubernice Nature Reserve, pitfall trap R	6568	leg. Klimeš & Špičáková, 1982
73 screes in the Krkonoše Mts.	5259, 5260	leg. V. Růžička, 1988–1989
74 screes on Mt. Králický Sněžník	5767	leg. V. Růžička, 1993–1994
75 Pec p. Sněžkou, on walls	5360	leg. L. Klimeš, 1996
76 Praha, on walls	5952	leg. L. Klimeš, 1996
77 Hradec Králové, on walls	5760, 5761	leg. L. Klimeš, 1996
78 Hradec Králové, on walls	5760, 5761	leg. L. Klimeš, 1987
79 Lednice, floodplain forest: soil and herb layer, sifting, sweeping	7166	Křístek 1991
80 Lednice, Ulmi-Fraxineta	7166	Obrtel 1976
81 Beskydy, Smrk Mt.	6476	Sechterová 1988
82 Prostějov, Čechovice, old field	6568	Sechterová 1987
83 Prostějov, Domamyslice, old field	6568	Sechterová 1987
84 Prostějov, Střichovice, old field	6568	Sechterová 1987
85 Prostějov, Ohrozim, old field	6468	Sechterová 1987

86	Křivoklátsko, Festucetalia valesiacae, Alyso-Potentilletum arenariae, Hyperico-Scleranthion, Trifolio-Geranietea	5949	Šmaha 1983
87	Křivoklátsko, Cynancho-Quercetum	5949	Šmaha 1983
88	Křivoklátsko, Cynancho-Quercetum/scree forest	5949	Šmaha 1983
89	Křivoklátsko, Genisto-Quercion	5949	Šmaha 1983
90	Křivoklátsko, Genisto-Quercion	5949	Šmaha 1983
91	Křivoklátsko, Galio-Carpinetum	5949	Šmaha 1983
92	Křivoklátsko, Aceri-Fraxinetum mercurialetosum	5949	Šmaha 1983
93	Křivoklátsko, Aceri-Carpinetum	5949	Šmaha 1983
94	Křivoklátsko, Aceri-Carpinetum	5949	Šmaha 1983
95	Křivoklátsko, Tilio-Acerion	5949	Šmaha 1983
96	Křivoklátsko, fragments of Acerion	5949	Šmaha 1983
97	Křivoklátsko, Aceri-Carpinetum	5949	Šmaha 1983
98	Křivoklátsko, Tilio cordatae-Fagetum	5949	Šmaha 1983
99	Křivoklátsko, fragments of Alnion	5949	Šmaha 1983
100	Křivoklátsko, fragments of Alnion	5949	Šmaha 1983
101	Křivoklátsko, xerothermic rocky steppe, Hyperico-Scleranthion perennis	6048	Šmaha 1984
102	Křivoklátsko, Quercion pubescentis	6048	Šmaha 1984
103	Křivoklátsko, a scree without vascular plants	6048	Šmaha 1984
104	Křivoklátsko, Aceri-Carpinetum, a scree forest	6048	Šmaha 1984
105	Křivoklátsko, Melampyro nemorosi-Carpinetum, subas. luzuletosum, acid form	6048	Šmaha 1984
106	Křivoklátsko, Melampyro nemorosi-Carpinetum, subas. luzuletosum, typical form	6048	Šmaha 1984
107	Křivoklátsko, Melampyro nemorosi-Carpinetum / Tilio cordatae-Fagetum	6048	Šmaha 1984
108	Křivoklátsko, Tilio cordatae-Fagetum with <i>Calamagrostis</i>	6048	Šmaha 1984
109	Křivoklátsko, Tilio cordatae-Fagetum with <i>Oxalis</i>	6048	Šmaha 1984
110	Křivoklátsko, Tilio cordatae-Fagetum with <i>Asperula odorata</i>	6048	Šmaha 1984
111	Křivoklátsko, the bank of the Prostřední potok stream, with ferns	6048	Šmaha 1984
112	Křivoklátsko, the bank of the Roudný stream with a <i>Fagus</i> forest	6048	Šmaha 1984
113	Křivoklátsko, the bank of the Roudný stream with an <i>Acer</i> forest	6048	Šmaha 1984
114	Třeboň, Wet meadows, ruderalized canal bank with <i>Urtica dioica</i>	6954	Klimeš 1997
115	Třeboň, Wet meadows, <i>Salix cinerea</i> shrub	6954	Klimeš 1997
116	Třeboň, Wet meadows, <i>Alopecurus pratensis</i> -dominated meadow	6954	Klimeš 1997
117	Třeboň, Wet meadows, wetland dominated by <i>Carex gracilis</i>	6954	Klimeš 1997

Revision of the genera *Lychas* and *Hemilychas*, with descriptions of six new species (Scorpiones: Buthidae)

František KOVAŘÍK

P. O. Box 27, CZ–145 01 Praha 45, Czech Republic

Received July 16, 1997; accepted September 16, 1997
Published December 29, 1997

Abstract. The genus *Lychas* C. L. Koch, 1845 is revised, with diagnostic characters and geographic distributions given for all of its species. Lectotypes and/or paralectotypes are designated for *Lychas asper obscurus* Kraepelin, 1913, *L. braueri* (Kraepelin, 1896), *L. baldasseroni* Caporiacco, 1947, *L. marmoreus kimberleyanus* Kraepelin, 1916, *L. marmoreus splendens* Kraepelin, 1916, *L. mjobergi* Kraepelin, 1916, *L. obsti* Kraepelin, 1913, *L. perfidus* (Keyserling, 1885), *L. shelfordi* (Borelli, 1904), *L. shoplandi* (Oates, 1888), *L. spinatus* Kraepelin, 1916, *L. tricarinatus* (Simon, 1884), *L. tweediei* Kopstein, 1937, and *L. variatus papuanus* (Thorcll, 1888). *L. asper obscurus* Kraepelin, 1913, is synonymized with the nominotypical *L. asper asper* (Pocock, 1891); *L. burdoi regulosus* Birula, 1916, and *L. burdoi rhodesianus* Lawrence, 1938, are synonymized with the nominotypical *L. burdoi burdoi* (Simon, 1882); *L. tweediei* Kopstein, 1937, is synonymized with *L. hosei* (Pocock, 1891); *L. mentawei* Roewer, 1943, *L. baldasseroni* Caporiacco, 1947, and *L. nucifer* Basu, 1964, are synonymized with *L. mucronatus* (Fabricius, 1798); *L. decoratus* Basu, 1964, is synonymized with *L. nigristeris* (Pocock, 1899); and *L. nigrimanus* Kraepelin, 1898, is synonymized with *L. scutillus* C. L. Koch, 1845. In contrast, *L. mjobergi* Kraepelin, 1916, is considered valid. *L. buchari* sp. n. (Australia), *L. farkasi* sp. n. (Nepal), *L. heurtautae* sp. n. (Nepal), *L. hillyardi* sp. n. (India), *L. lourencoi* sp. n. (Indonesia), and *L. rackae* sp. n. (India) are described and a key for species of the genus *Lychas* is provided. First record of *L. laevifrons* (Pocock, 1897) for Nepal, *L. shelfordi* (Borelli, 1904) for Indonesia are established. The genus *Hemilychas* Hirst, 1911, with the type species *Hemilychas alexandrinus* Hirst, 1911, is re-defined and differentiated from *Lychas* by the fifth metasomal segment which is without keels and punctate (as in *Orthochirus* Karsch, 1892) rather than granulate or smooth.

Taxonomy, description, revision, new species, new combination, checklist, key, Scorpiones, Buthidae, *Lychas*, *Hemilychas* stat. n., Afrotropical region, Oriental region, Australia

INTRODUCTION

The genus *Lychas* includes 35 species occurring from Afrotropical region through Seychelles and Mauritius Islands, Indo-Malayan region, and southern part of the Palearctic region (China, Nepal) to Australia (Table 2). The wide distribution is probably accountable for the lack of a comprehensive revision. Type specimens are in a number of institutions, e. g. the holotype of *L. burdoi* in the Muséum national d'Histoire naturelle in Paris, the holotype of *L. burdoi rhodesianus* in the Transvaal Museum in Pretoria, and the holotype of *L. burdoi regulosus* allegedly in the Zoological Institute of the Russian Academy of Sciences in St. Petersburg (where it could not have been located, however). Other type specimens are at museums in Germany, England, Australia, and India, making a revisionary work difficult and time-consuming. Fortunately, most of the institutions contacted kindly made available to me type specimens as well as their unidentified material of *Lychas*, which has allowed me to include all of FKCP, HNHN, MZUF, NMPC, SMFD, ZMHB, and ZMUH *Lychas* and most of the NHMB and MNHM holdings. Unfortunately, I have not been able to examine either types or any other specimens of seven *Lychas* species, including "*Lychas* sp.?" from Sri Lanka noted by Vachon (1982: 85).

MATERIAL AND METHODS

The institutional abbreviations listed below and used throughout are mostly after Arett et al. (1993), only FKCP and MBCZ are my own.

BMNH: British Museum (Natural History), London, England
FKCP: František Kovařík Collection, Prague, Czech Republic
HNHM: Hungarian Natural History Museum, Budapest, Hungary
MBCZ: Matt E. Braunwalder Collection, Zurich, Switzerland
MCSN: Museo Civico de Storia Naturale „Giacomo Doria“, Genova, Italy
MNHN: Muséum national d'Histoire naturelle, Paris, France
MRSN: Museo Regionale di Scienze Naturali, Torino, Italy
MZUF: Museo Zoologico de „La Specola“, Firenze, Italy
NHMB: Naturhistorisches Museum Basel, Switzerland
NMPC: National Museum (Natural History), Praha, Czech Republic
NZSI: National Zoological Survey of India, Calcutta, India
UZMD: Universitets Zoologiske Museet, Copenhagen, Denmark
SMFD: Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main, Germany
TMSA: Transvaal Museum, Pretoria, Republic of South Africa
ZMHB: Museum für Naturkunde der Humboldt-Universität zu Berlin, Germany
ZMUH: Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany

Other abbreviations are as follows:

M: male
F: female
A: specimens preserved in alcohol
E: specimens mounted dry
im: immature
TL: type locality
HT: holotype
AT: allotype
PT: paratype
LT: lectotype
PLT: paralectotype
ST: syntype

Type localities are given exactly as in the original descriptions. Type locality is followed by the repository of the holotype or lectotype.

Under material, the country is followed by all information given on the locality label.

Unfortunately, some locality labels are difficult to read, e. g. the original labels of *L. burdoi* at ZMHB dating from 1890–1920, which may have caused a few inaccuracies in their transcription. Certain label data have proven altogether undecipherable.

All specimen numbers including those of Prof. Max Vachon (e. g. VA 2467) are given for the sake of completeness, although Dr Lourenço has informed me that no notations pertaining to Vachon's numbers appear to have been preserved.

This study was conducted in 1995–1997. Each examined specimen bears a label in Ariel or Times New Roman font produced on a laser printer. The label contains the generic and species name; author and year of the original description; whether the specimen is the holotype, lectotype, or paralectotype; whether I have designated (dsg.), determined (det.), or only revised (rev.) the specimen; and my name plus the year of the examination.

Lychas C. L. Koch, 1845 (Figs 1–116, 122, 123, Tables 1–3)

Pilumnus C. L. Koch, 1837: 38 (praeocc. by *Pilumnus* Leach, 1815: Crustacea) = *Repucha* Francke, 1985: 12, nom. nov. (syn. by Francke 1985: 12).

Scorpio (*Androctonus*): Gervais, 1843: 129.

Scorpio (*Androctonus*) [sic]: Gervais, 1844: 207 (in part).

Lychas C. L. Koch, 1845b: 3 (in part); 1850: 92 (in part); Pocock, 1899: 834; 1900: 35; Purcell, 1902: 173 (in part); Kraepelin, 1905: 335; 1908: 87; 1911: 60; 1913: 132, 172; 1916: 22 (in part); Birula, 1917a: 105 (in part); 1917b: 164;

Kopstein, 1921: 121; Glauret, 1925: 94 (in part); Werner, 1934: 271; Roewer, 1943: 210; Takashima, 1945: 73 (in part); Vachon, 1953: 10; Probst, 1973: 322; Vachon, 1974: 906; Lamoral & Reynders, 1975: 510 (in part); L. E. Koch, 1977: 123 (in part); Newlands & Martindale, 1980: 69; L. E. Koch, 1981: 875 (in part); Vachon, 1982: 84; Tikader & Bastawade, 1983: 40; Vachon, 1985: 99; 1986: 845 (in part); Sissom, 1990: 102 (in part); Locket, 1993: 593 (in part); Kovařík, 1995: 189 (in part).
Lychus [sic]: Kraepelin, 1907: 193.
Lichas [sic]: Fage, 1933: 26; 1936: 179.
Lachas [sic]: Fage, 1944: 71.
Lycas [sic]: Hadley, 1974 (Francke 1985: 9).
Lyches [sic]: Minocci, 1974: 2.
Tityus: C. L. Koch, 1845a: 14 (in part).
Tithyus: C. L. Koch, 1850: 90 (in part).
Isometrus: Thorell, 1876: 129 (in part); Pocock, 1891: 433.
Archisometrus Kraepelin, 1891: 217 (in part); Werner, 1934: 271; Pocock, 1893: 306; Kraepelin, 1895: 84; Pocock, 1897: 110 (in part); Lönnberg, 1897: 195; Kraepelin, 1898: 3; 1899: 41; 1905: 196 (syn. by Pocock 1900: 35).
Archisometrus [sic]: Stahnke, 1972: 128.
Lychas (*Distotrichus*) Tikader & Bastawade 1983: 41 (syn. by Vachon, 1986: 848).
Lychas (*Alterotrichus*) Tikader & Bastawade 1983: 52 (syn. by Kovařík, 1995: 188).
Lychas (*Endotrichus*) Tikader & Bastawade 1983: 71 (syn. by Kovařík, 1995: 188).

TYPE SPECIES. *Lychas scutillus* C. L. Koch, 1845.

DIAGNOSTIC CHARACTERS. A combination of characters differentiates this genus from all other genera of the family Buthidae. The basic trichobothrial pattern is beta (Figs 96–102 and Sissom 1990: 70, fig. 3.3), the third and fourth legs have well developed tibial spurs, pectines bear fulcra (Sissom 1990: 92, fig. 3.17d), movable fingers of pedipalps have six cutting edges (rows of granules) (Figs 2–20), in lateral view the entire dorsal surface of the carapace is horizontal, the cheliceral fixed finger has a single ventral denticle, and the telson has a distinct subaculear tooth that is less pronounced only in *L. mjobergi*. The fifth metasomal segment has keels and is smooth or granulate, not punctate (Fig. 1).

The genus is further characterized by one (most species) or three (*L. braueri*, *L. farkasi* sp. n. and some *L. laevifrons* and *L. tricarinatus*) dorsal mesosomal keels, total length of 21.8 through 86.5 mm, 8 through 26 pectinal teeth (Table 3), and eight or 10 keels on the first and second metasomal segments. The third mesosomal segment may bear as few as six and as many as 10 keels.

The color pattern is usually spotted. The base color is often yellow, with dark spots of varying size, but some species may lack spotting.

COMMENTS. L. E. Koch (1977: 123) considered *Lychas* C. L. Koch, 1845, to be a synonym of *Isometrus* Hemprich & Ehrenberg, 1828 (figured in 1828 and described in 1829). According to L. E. Koch (1977), the genus *Lychas* was described by C. L. Koch only in 1850.

It is true that C. L. Koch (1845) listed *Lychas maculatus* (= *Isometrus maculatus*) first, *Lychas americanus* (= *Isometrus maculatus*) second, and *Lychas scutillus* only third, although the latter was selected as the type species of the genus *Lychas* C. L. Koch, 1845, in accord with the rules of zoological nomenclature as then defined (Pocock, 1899: 834), and has been used as such since then (Pocock, 1900: 35; Vachon, 1985: 99; Vachon, 1986: 837). The taxonomic position of the genus *Lychas* has been discussed in detail by Vachon (1985).

The genus *Lychas* includes 35 species. Its vast distribution and attempts to better understand relationships among the species have led to division into several subgenera. Hirst (1911) erected the Australian subgenus *Hemilychas* with type species *Lychas* (*Hemilychas*) *alexandrinus* Hirst, 1911. L. E. Koch (1977) compared Hirst's characters with other species of the genus and concluded that they do not justify subgeneric status. However, examination of the holotype of *Ly-*

chas (*Hemilychas*) *alexandrinus* convinces me that it belongs in a separate genus *Hemilychas* (see below).

Tikader & Bastawade (1983) divided *Lychas* into the subgenera *Distotrichus*, *Alterotrichus*, and *Endotrichus*. In discord with the international rules of zoological nomenclature, none of their subgenera has been named *Lychas*. The subgenera are differentiated on distribution of the trichobothria dt, db, et, and est (Figs 56–66, Tikader & Bastawade 1983: 41; Vachon 1986: 847, figs 22–24). This distinction was doubted by Vachon (1986), because the distribution of these trichobothria varies even intraspecifically (Kovářik, 1995: 188).

***Lychas albimanus* Henderson, 1919**

(Tables 2–3)

Lychas albimanus Henderson, 1919: 379; Takashima, 1945: 84; L. E. Koch, 1977: 124; Kovářik, 1995: 189.

Lychas (*Endotrichus*) *albimanus*: Tikader & Bastawade, 1983: 91.

TYPE LOCALITY. India, Cochin State, Teak Forests; NZSI.

DIAGNOSTIC CHARACTERS. Total length 36 mm (Tikader & Bastawade 1983: 92) through 41 mm (Henderson 1919: 380). Sixth cutting edge on movable finger of pedipalps without external and internal granules (Tikader & Bastawade 1983: 93, fig. 244). First and second metasomal segments with 10 keels (second segment has two keels weakly developed), third and fourth segments with eight keels (Tikader & Bastawade 1983: 94). For position and distribution of trichobothria on tibia, patella, and femur of pedipalps see Tikader & Bastawade 1983: 95, figs 250–255. Pectinal teeth number 21 (Henderson 1919: 380; Tikader & Bastawade 1983: 94). Fingers of tibia of pedipalps are black and manus of tibia is white or yellowish (Henderson 1919: pl. 21, fig. 1; Tikader & Bastawade 1983: 93, figs 242–243).

COMMENTS. The species is based on three specimens obtained by F. H. Gravely and B. Sundara Raj in September 1914 (Henderson 1919: 379). The description does not permit to ascertain whether the type series includes only females or both sexes.

Unfortunately, I have not been able to examine the types or any other specimens of this species, and the diagnostic characters are therefore based solely on the authors cited.

DISTRIBUTION. India (Henderson 1919: 379).

***Lychas asper* (Pocock, 1891)**

(Figs 2, 22, 54, 56–57, 112–115, Tables 1–3)

Isometrus asper Pocock, 1891: 445.

Archisometrus asper: Kraepelin, 1895: 86; 1899: 49.

Lychas asper: Pocock, 1899: 834; Hirst, 1911: 4; Kraepelin, 1913: 173; Lampe, 1918: 194; Loveridge, 1925: 307; Geeracerts, 1953: 1065; Belfield, 1956: 45; Lamoral & Reynders, 1975: 510; Farzanpay & Vachon, 1979: 140; Kovářik, 1995: 189.

Lychas asper obscurus Kraepelin, 1913: 174 (TL: Tanganjika, Kawende); Birula, 1915: 30; 1916: 51; Werner, 1916: 87; Lampe, 1918: 194; Borelli, 1925: 16; Moriggi, 1941: 91; Probst, 1973: 323; Lamoral & Reynders, 1975: 510; Moritz & Fischer, 1980: 320; Kovářik, 1995: 189. *Syn. n.*

Archisometrus asper obscurus: Caporiacco, 1937: 360; 1941: 35; El-Hennawy, 1992: 127.

TYPE LOCALITY. Congo; BMNH.

TYPE MATERIAL. **Tanzania**: Centr. Africa, Kawende, 3FA (lectotype, paralectotypes No. 3 and 4 of *L. asper obscurus*), leg. P. Reinhardt, ZMHB No. 7591; D. O. Africa, IMA (im) (paralectotype No. 1 of *L. asper obscurus*), leg. Glanning, ZMHB No. 8147; Tanzania-see, IMA (im) (paralectotype No. 2 of *L. asper obscurus*), leg. Böhm, ZMHB No. 10426; D. O. Afrika, Mkalama, X.1912, 1FA (paralectotype No. 5 of *L. asper obscurus*), leg. Obst. No. 471, ZMUH; D. O. Afrika, Mkalama, X.1912, IMA (paralectotype No. 6 of *L. asper obscurus*), 1FA (paralectotype No. 7 of *L. asper obscurus*), leg. Obst.

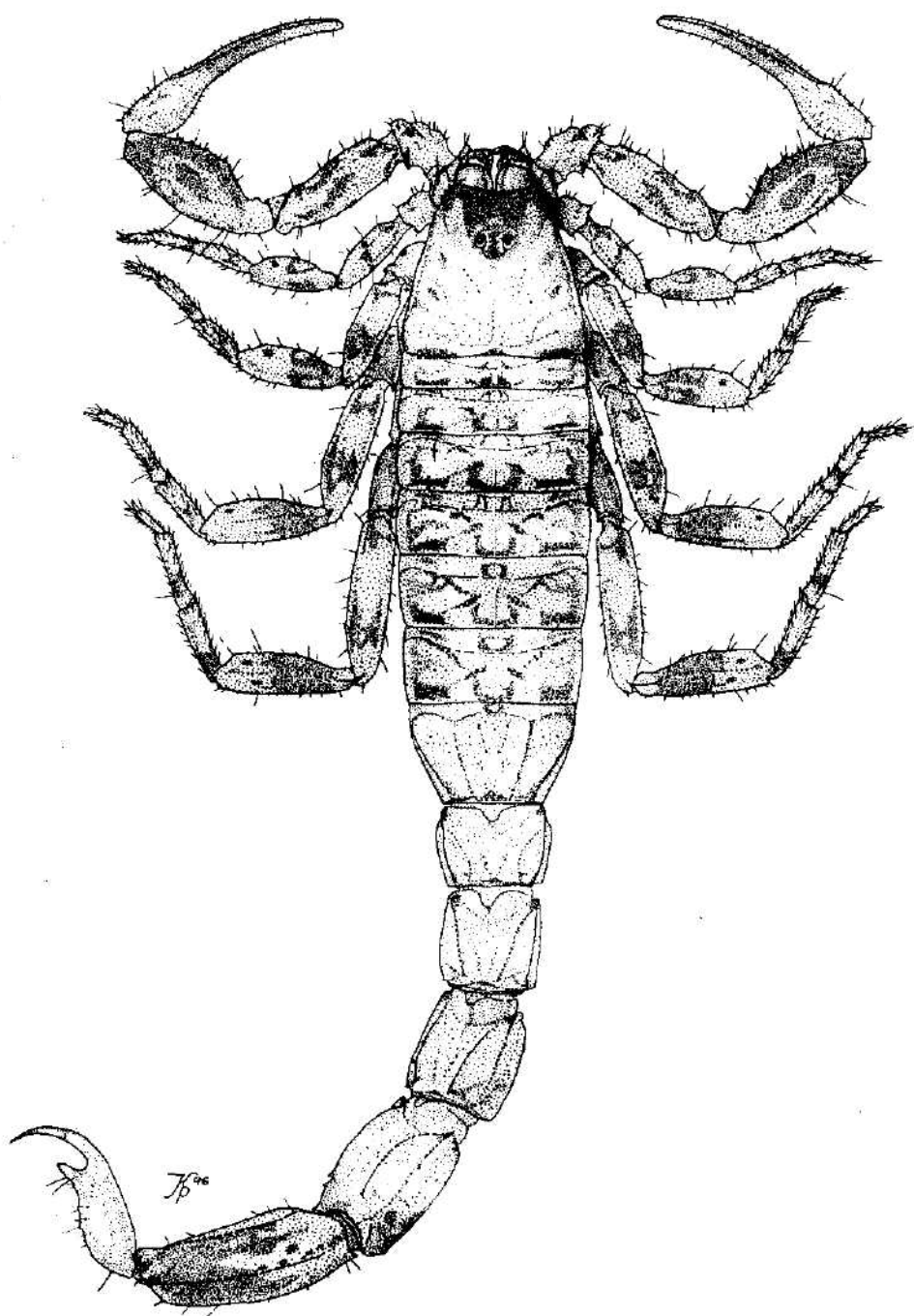


Fig. 1—*Lychas burdoi* (Simon), female from FKCP (Tanzania). Dorsal aspect.

Table 1. Measurements (in millimeters) of *Lychas* and *Hemilychas* species. Line denoted "pectinal teeth" contains number of both left and right teeth separated by a colon

	total length	carapace length	width	metasoma total length	I length	width	II length	width	III length	width	IV length	width	V length	width	VI length	width	tel. length	pedipalp femur length	patella length	tibia length	ma. fin. length	pec- tinal teeth	
<i>Lychas asper</i>																							
M, MNHN	53.4	4.6	4.7	31.8	3.5	2.4	4.3	2.1	4.9	2.0	5.3	1.9	7.5	1.9	5.2	4.3	1.3	5.1	1.6	7.7	1.7	4.4	18:17
M, FKCP	32.8	3.3	3.1	20.3	2.4	1.6	2.7	1.7	2.9	1.6	3.5	1.5	4.7	1.4	3.7	3.0	0.8	3.3	1.2	5.2	1.0	3.3	19:19
F, LT L. <i>s. obscurus</i>	30.4	3.4	3.2	17.0	2.0	1.7	2.2	1.5	2.4	1.5	3.1	1.4	4.0	1.4	3.2	3.0	0.9	3.0	1.3	4.9	0.9	3.0	16:16
F, BMNH	29.6	3.1	3.1	16.5	1.8	1.6	2.0	1.4	2.3	1.4	3.0	1.4	4.1	1.4	3.3	2.5	0.7	3.2	1.1	4.8	0.8	3.3	14:14
<i>L. braueri</i>																							
M, ZMHB	25.0	2.9	2.6	15.0	1.6	1.5	1.8	1.4	1.9	1.4	2.5	1.4	3.9	1.4	3.0	2.2	0.7	3.3	0.8	3.9	0.7	2.8	17:17
F, LT, ZMUH	33.7	3.9	3.7	19.8	2.1	2.1	2.5	1.9	2.6	1.9	3.2	1.9	5.0	1.8	4.3	3.3	0.9	4.2	1.3	5.8	1.0	4.1	17:17
<i>L. buchari</i> sp. n.																							
M, HT, MNHN	42.4	5.1	5.0	27.4	3.2	2.7	3.8	2.5	3.8	2.5	4.7	2.4	5.8	2.4	6.1	3.4	1.2	4.3	1.6	6.5	1.7	4.4	26:26
<i>L. burdoi</i>																							
M, ZMHB	31.4	3.7	4.0	19.1	2.2	2.4	2.3	2.2	2.5	2.1	3.3	2.0	4.5	1.9	4.0	2.9	0.9	3.5	1.4	5.3	1.0	3.3	16:16
F, HT, MNHN	32.5	3.9	3.8	17.5	2.1	2.1	2.2	2.0	2.4	1.8	3.3	1.8	4.3	1.8	3.4	3.1	0.9	3.7	1.4	5.7	0.9	4.1	16:15
F, HT L. <i>rhodesianus</i>	36.3	3.6	3.8	18.9	2.1	2.4	2.3	2.1	2.5	2.1	3.3	2.0	4.5	2.0	3.9	3.2	1.0	3.9	1.4	5.5	1.0	4.0	14:15
<i>L. farkasi</i> sp. n.																							
M, HT, MNHN	41.4	4.5	4.6	25.6	3.2	2.6	3.9	2.6	4.1	2.6	4.7	2.7	5.3	2.8	4.3	4.0	1.1	4.1	1.6	6.4	1.8	3.5	25:25
<i>L. flavimanus</i>																							
M im, HT, MCSN	33.0	3.4	3.1	19.3	2.1	1.9	2.8	1.7	2.9	1.7	3.4	1.7	4.8	1.7	3.6	3.2	1.0	3.8	1.0	5.5	1.1	3.7	19:19
F, ZMUH	39.4	4.1	3.9	20.9	2.3	2.3	2.7	2.1	2.9	2.1	3.8	2.1	5.0	2.1	4.2	3.7	1.1	4.6	1.4	6.4	1.2	4.2	16:16
<i>L. hendersoni</i>																							
F, HT, BMNH	34.0	3.7	3.8	18.5	2.1	2.2	2.5	2.0	2.8	2.0	3.2	2.0	4.2	2.0	3.3	3.0	0.9	3.7	1.2	5.2	1.0	3.6	17:18
<i>L. heurtaultae</i> sp. n.																							
M, HT, MNHN	37.1	3.3	3.4	20.6	2.2	2.0	2.7	1.9	3.0	1.8	3.8	1.8	4.7	1.7	3.9	2.9	0.9	3.9	1.2	5.3	1.4	3.3	24:23
F, AT, FKCP	41.4	4.0	4.1	20.9	2.4	2.4	2.9	2.3	3.2	2.3	3.7	2.1	4.7	2.0	3.7	3.1	1.0	4.3	1.4	5.6	1.5	3.4	21:21
<i>L. hillyardi</i> sp. n.																							
M, HT, NMPC	28.1	2.8	2.7	15.8	1.9	1.7	2.2	1.5	2.3	1.4	2.8	1.4	3.4	1.4	3.2	3.0	0.8	3.4	1.2	5.0	0.9	3.6	17:18
<i>L. hosei</i>																							
F, HT, BMNH	61.9	6.9	6.2	35.2	4.1	3.2	5.2	3.1	5.2	3.0	5.9	2.8	7.7	2.7	7.1	5.9	1.8	7.6	2.3	12.0	2.0	7.8	21:20
F, LT L. <i>tweediei</i>	69.2	7.3	7.1	40.5	4.5	3.0	6.0	2.9	6.0	2.8	6.6	2.7	9.3	2.9	8.0	7.8	1.9	8.4	2.6	13.2	2.2	9.0	18:18
F, ZMHB	66.8	6.2	6.6	35.9	4.1	3.0	5.0	2.8	5.6	2.8	6.1	2.7	7.8	2.8	6.9	6.3	1.7	7.3	2.4	11.2	2.0	7.6	18:19
<i>L. infuscatus</i>																							
F, ZMUH	36.5	4.2	4.4	20.9	2.0	2.4	2.3	2.3	2.5	2.2	3.0	2.1	4.7	2.0	4.2	3.5	1.1	4.3	1.6	6.0	1.2	4.1	11:11
F, FKCP	32.8	3.6	3.6	17.7	1.8	2.1	2.0	2.0	2.3	1.8	3.0	1.8	4.3	1.8	3.9	3.1	1.0	3.9	1.4	5.3	1.2	3.7	10:10
<i>L. krati</i>																							
M, FKCP	42.2	4.2	4.0	27.7	3.4	2.1	3.9	1.9	4.3	1.8	4.7	1.7	6.0	1.8	4.9	4.0	1.1	4.5	1.8	7.3	1.8	4.4	17:18
F, HT, FKCP	37.1	4.7	5.0	23.2	2.7	2.3	3.3	2.0	3.7	1.9	4.3	1.8	5.3	1.7	4.2	4.3	1.2	4.9	1.7	7.5	1.3	5.4	16:15
F, PT no. 5, FKCP	36.4	5.3	4.5	21.9	2.5	2.3	3.0	2.0	3.4	1.9	4.2	1.9	5.0	1.8	3.8	3.8	1.1	4.2	1.6	6.5	1.2	4.2	16:16
<i>L. laevitrons</i>																							
F, ZMUH	58.2	5.4	5.4	30.9	3.5	3.3	4.2	3.1	4.5	3.0	5.4	2.9	6.9	2.6	5.9	4.8	1.4	5.9	1.9	7.5	1.8	5.2	23:23
F, MNHN	53.2	5.1	5.3	28.2	3.3	3.0	3.8	2.8	4.1	2.7	5.2	2.6	6.3	2.5	5.2	4.0	1.3	5.4	1.7	7.3	1.6	4.6	23:24
<i>L. laurenci</i> sp. n.																							
F, HT, MNHN	27.9	3.3	3.4	15.7	1.9	1.6	2.2	1.4	2.4	1.3	2.9	1.2	3.8	1.2	3.2	3.0	0.8	3.7	1.2	5.2	0.9	3.8	11:12
<i>L. mamoreus</i>																							
M, FKCP	34.0	3.2	3.1	21.0	2.1	1.5	2.7	1.4	2.9	1.4	4.0	1.4	5.3	1.4	4.1	2.8	1.0	3.4	1.3	5.4	1.2	3.5	16:16
F, FKCP	31.7	3.3	3.4	17.5	1.8	1.6	2.1	1.5	2.6	1.4	3.2	1.3	4.2	1.3	3.7	2.8	0.9	3.1	1.3	4.9	1.0	3.3	12:12
F, HT L. <i>m. obscurus</i>	32.0	3.5	3.5	19.0	2.1	1.8	2.5	1.6	2.7	1.5	3.3	1.4	4.5	1.4	3.8	3.0	0.9	3.4	1.2	5.0	1.0	3.3	15:15
<i>L. mjabergii</i>																							
F, LT, ZMUH	32.4	3.9	4.1	19.1	2.2	2.3	2.7	2.1	2.7	2.1	3.1	2.0	3.8	2.0	4.1	2.5	1.0	3.2	1.4	4.9	1.3	3.2	21:21
<i>L. mucronatus</i>																							
M, FKCP	50.0	5.8	5.9	31.7	3.6	3.4	4.3	3.2	4.7	3.1	5.8	3.0	7.1	3.0	6.0	5.8	1.3	6.3	1.9	10.4	2.6	7.1	22:23
F, ST L. <i>chinensis</i>	54.0	6.1	6.3	30.5	3.6	3.4	4.0	3.0	4.4	2.8	5.4	2.9	6.5	2.9	6.1	5.4	1.6	6.2	2.1	9.6	1.9	6.2	23:23
F, HT L. <i>mentawaiensis</i>	57.0	5.8	5.9	31.0	3.5	3.3	4.1	3.1	4.3	2.9	5.2	2.9	7.0	2.5	6.0	5.4	1.4	6.4	2.0	9.4	1.9	6.5	20:20
<i>L. nigristernis</i>																							
M, FKCP	40.4	3.9	3.9	27.0	3.2	2.0	3.8	1.8	4.0	1.7	4.9	1.7	6.1	1.6	4.1	4.2	0.9	4.8	1.2	7.1	1.2	4.8	16:16
F, HT, BMNH	38.0	4.2	4.2	22.0	2.5	2.2	3.0	2.0	3.3	2.0	3.8	1.8	5.0	1.7	4.1	3.2	1.1	4.4	1.5	5.8	1.1	4.0	15:15
F, FKCP	45.2	4.7	4.8	26.7	3.0	2.6	3.5	2.2	4.8	2.1	5.0	2.1	5.8	2.0	4.7	4.6	1.1	5.4	1.4	7.7	1.4	5.6	14:15
<i>L. obsti</i>																							
M, FKCP	41.9	3.8	3.6	28.2	3.6	1.9	4.0	1.7	4.5	1.5	5.5	1.5	6.0	1.6	4.8	3.6	1.0	3.9	1.3	5.7	1.2	3.5	18:17
F, LT, ZMUH	38.4	3.7	3.7	19.9	2.3	1.9	2.6	1.6	3.1	1.7	3.6	1.8	4.5	1.4	3.6	3.0	0.9	3.5	1.3	4.9	1.1	3.0	17:18
<i>L. perfidus</i>																							
M im, ZMUH	25.5	2.9	2.8	15.0	1.5	1.7	1.7	1.6	1.9	1.5	2.4	1.4	3.7	1.4	3.7	2.2	0.7	2.9	1.0	4.5	1.2	2.6	12:12
F, LT, BMNH	30.0	3.5	3.5	17.0	1.6	2.0	2.0	1.9	2.1	1.8	2.6	1.8	4.1	1.6	4.1	2.8	0.9	3.5	1.3	5.4	1.4	2.9	11:10
F, ZMUH	40.6	4.1	4.6	22.5	2.3	2.6	2.5	2.3	2.8	2.2	3.4	2.1	5.0	2.1	5.1	3.7	1.0	4.2	1.5	6.5	1.3	4.5	10:11
<i>L. rackae</i> sp. n.																							
M, HT, ZMUH	36.7	3.7	3.7	22.4	2.5	2.1	3.0	1.8	3.1	1.8	4.0	1.8	5.0	1.8	4.0	3.5	1.0	4.2	1.5	6.4	1.6	3.8	17:18

	total length	carapace length width	metasoma total I length width II length width III length width IV length width V length width tel. length width										pedipalp femur length width	patella length width	tibia length width	ma length width	fin. length width	pec- tinal teeth
<i>L. rugosus</i> M, HT, BMNH	21.8	2.5 2.6	12.1 1.4 1.2 1.6 1.1 1.7 1.1 2.0 1.0 2.8 1.0 2.4	2.2 0.7 2.5 0.9 3.7 0.8 2.3	12:12													
<i>L. scaber</i> M, BMNH F, BMNH	38.1 —	3.7 3.8 4.7 4.7	25.5 2.8 2.0 3.3 1.6 4.1 1.5 4.8 1.4 5.5 1.5 4.5 — 3.1 2.4 — — — — — — — — — —	3.6 1.1 4.6 1.6 7.2 1.4 5.2 4.5 1.2 5.2 1.7 8.3 1.4 5.9	19:20 19:18													
<i>L. sheffordi</i> M, LT, MRSN F, PLT, MRSN	41.0 44.2	4.7 4.8 4.7 4.8	26.0 2.7 2.7 3.2 2.4 3.6 2.3 4.3 2.2 6.4 2.2 5.6 25.8 2.8 2.5 3.2 2.3 3.5 2.2 4.2 2.0 6.1 2.0 5.6	4.5 1.3 5.7 1.6 7.5 1.4 5.6 4.3 1.1 5.5 1.7 7.6 1.4 5.5	12:12 12:12													
<i>L. scutellus</i> M, FKCP F, ST <i>L. weberi</i>	86.5 56.0	6.5 5.8 5.7 5.6	62.0 7.5 2.3 9.4 2.1 10.2 1.9 10.8 1.8 12.6 1.7 9.2 34.6 4.0 2.4 5.0 2.3 5.2 2.1 7.1 1.9 7.3 1.8 6.0	8.0 1.4 8.6 2.1 12.5 1.9 8.2 5.3 1.5 6.9 2.2 9.5 1.6 7.0	18:17 17:16													
<i>L. shoptlandi</i> F, LT, BMNH	50.7	5.6 5.6	30.0 3.5 3.3 4.5 3.1 4.7 3.1 5.5 3.0 8.1 2.7 5.7	4.1 1.5 5.0 1.8 7.1 1.7 4.3	23:23													
<i>L. tricarinalis</i> M, FKCP F, LT, MNHN F, SMFD	48.4 44.3 54.7	4.2 4.0 4.2 4.1 5.1 4.8	28.9 3.6 2.3 4.3 2.3 4.7 2.3 5.5 2.3 6.4 2.3 4.2 28.6 3.5 2.8 3.5 2.7 4.2 2.7 4.7 2.6 5.8 2.5 4.2 27.7 3.6 3.1 4.1 3.0 4.3 2.8 5.2 2.9 6.0 2.6 4.5	4.1 1.0 5.0 1.4 6.9 1.5 3.9 4.1 1.0 4.3 1.4 6.7 1.3 3.5 4.1 1.1 5.0 1.6 7.1 1.5 4.1	22:23 25:25 22:22													
<i>L. variatus</i> M, ZMHB F, LT <i>L. spinatus</i>	38.8 46.4	4.0 4.1 4.9 4.9	23.5 2.8 2.5 3.2 2.3 3.4 2.2 4.1 2.1 5.2 2.0 4.6 24.7 2.7 2.9 3.2 2.4 3.5 2.3 4.2 2.3 5.6 2.4 5.5	3.8 1.3 4.5 1.6 7.0 1.7 4.4 3.8 1.3 4.9 1.7 7.3 1.5 4.8	21:22 19:19													
<i>H. alexandrinus</i> M, HT, BMNH	31.5	3.5 3.7	18.4 2.5 2.2 2.6 2.3 2.6 2.3 3.1 2.3 3.8 2.5 3.8	2.6 0.9 3.2 1.3 5.2 1.2 3.7	20:21													

ZMUH. Zambia: N. W. Rhodesia, Brooken Hill, 20.IV.1911, 2FA (paralectotypes Nos 8–9 of *L. asper obscurus*), leg. P. Timmen, ZMUH.

OTHER MATERIAL. Angola: 6M3F1 juv. A, MNHN Nos RS 1029, 3826, 4980, 8057; W. Afr., Ambrizelti, 6.III.1890, 1FA, leg. Cpt. Hupfer, ZMUH; W. Afr., Landana, 22.VII.1892, 3M2F1 juv. A, leg. H. Brauns, ZMUH; W. Afr., Ambriz, 1893, 1FA, Mus. Leyden, ZMUH. ? Angola, West Africa, Mus. Berlin, 1M2FA, ZMUH; West Africa, 1925, 1FA, FKCP. Congo Republic: 2FA, coll. J. Pinnock, BMNH No. BM 1899.4.18.2–3; IMA, FKCP; Congo (or Sierra Leone or Senegal), 6M28FA, coll. Simon, MNHN No. RS 1473. Mozambique: Tete, IV.1947, 8FA, SMFD No. 10085–6; Tete, V.1980, 1M3FA, leg. P. Dvořák, FKCP. ? West Africa, IMA, ZMHB No. 7571, 4M19F1 juv. A, leg. Falkenstein, ZMHB No. 7513; ? West Africa, 3FA, ZMHB No. 7464, 1FA, ZMHB No. 7175; 1M1FA, FKCP; Heymans, 1M3FA, MNHN No. RS 5039; West Africa, Landana, 22.VII.1929, 1M1F1 juv. A, leg. H. Brauns, ZMUH.

DIAGNOSTIC CHARACTERS. Total length 25–53.4 mm. In contrast to female, male has longer metasoma (but not as long as in *L. obsti*, see Table 1) and fingers of pedipalps slightly twisted proximally. Sixth cutting edges on movable and fixed fingers of pedipalps with two external granules each (Fig. 2), and in some instances also with one internal granule. First and second metasomal segments with 10 keels, third a fourth segments with eight keels. Ventral surface of seventh mesosomal segment with two or four keels that may be inconspicuous. For position and distribution of trichobothria on tibia of pedipalps see Figs 56 and 57. Pectinal teeth number 12–19.

In the specimens from Mozambique the legs are dorsally spotted and ventrally yellowish brown. The mesosomal segments are dark with six yellowish spots on the posterior margin. The metasoma is spotted, progressively darker posteriorly, and the fifth segment is entirely black; the telson is yellowish brown, however. The femur of the pedipalps is yellow with black spots, the patella is black with a minimum of light spots, and the manus is even lighter-colored than the fingers of the pedipalps. Manus may be rarely darker than fingers.

COMMENTS. This species is based on two specimens, a female from Angola and a male from the Congo (Pocock 1891: 447). According to Pocock the female is 30 mm long and the male is 36 mm long, and there are 14 pectinal teeth.

I examined two females from the Congo, both identified by Pocock in 1895, and they agree with Pocock's (1891: 445–447) description. One of them still has pectinal teeth preserved, and

they number 14 and 15. A century of preservation in alcohol has resulted in loss of the original color, but spotting on legs is still discernible.

I examined the type series of *L. asper obscurus* and designated a lectotype and paralectotypes Nos 1–9. All males are immature but nevertheless show sexual dimorphism in the length of the metasoma. Pectinal teeth of types number 17–18 in the males and 15–17 in the females from Tanzania and 15 in the females from Zambia.

I arrived at the opinion that *L. asper obscurus* and *L. asper asper* are synonyms only after examining a number of specimens and particularly the paralectotypes Nos. 7–9 of *L. asper obscurus* from Tanzania and Zambia. The shape of telson and of subaculear tubercle (see Figs 112–115) proved variable, and the existence of two subspecies is refuted also by geographic distribution. For instance, in the MNHN material from Angola are specimens that show features of both subspecies.

Since I at first thought that the subspecies are valid, the initially examined specimens are incorrectly labeled as subspecifically distinct.

DISTRIBUTION. Angola, the Congo Republic (Pocock 1891: 447), Congo Democratic Republic (former Zaire) (Geeraerts, 1953: 1065), Tanzania (Kraepelin 1913: 176), Mozambique (Hirst 1911: 4), Somalia (Borelli 1925: 16), and Zambia (Kraepelin 1913: 176).

***Lychas biharensis* Tikader & Bastawade, 1983**
(Tables 2–3)

Lychas (Endotrichus) biharensis Tikader & Bastawade, 1983: 96.

Lychas biharensis: Kovarik, 1995: 189.

TYPE LOCALITY. India, Bihar, Dist. Manbhum, Chaurasi; NZSI.

DIAGNOSTIC CHARACTERS. Total length 46.25 mm (Tikader & Bastawade 1983: 98). Sixth cutting edge on movable finger of pedipalps without external and internal granules (Tikader & Bastawade 1983: figs 260 and 270). First through third metasomal segments with 10 keels (third segment has two lateral keels sparsely but clearly granular), fourth segment with eight keels (Tikader & Bastawade 1983: 101). Second through sixth mesosomal segments with one dorsal carina. For position and distribution of trichobothria on tibia, patella, and femur of pedipalps see Tikader & Bastawade 1983: 99, figs 266–270. Pectinal teeth number 24 (Tikader & Bastawade 1983: 100).

COMMENTS. The species is based on two females obtained by T. B. Sinha on 26 September 1948 (Tikader & Bastawade 1983: 101). Unfortunately, I have not been able to examine the types or any other specimens of this species, and the diagnostic characters are therefore based solely on the authors cited.

DISTRIBUTION. India (Tikader & Bastawade 1983: 101).

***Lychas braueri* (Kraepelin, 1896)**
(Figs 1, 42, 58, 95, 97, Tables 1–3)

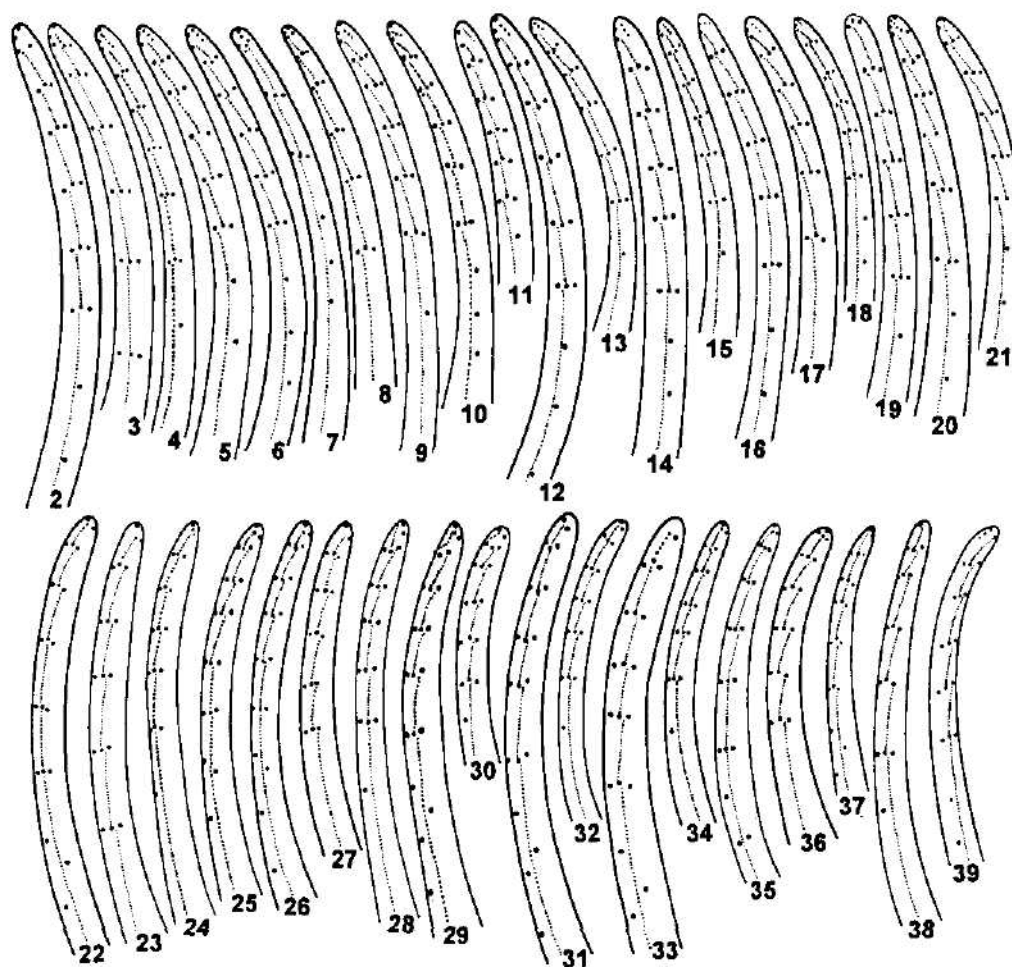
Archisometrus braueri Kraepelin, 1896: 123; 1899: 46; Hirst, 1913: 32.

Lychas braueri: Lamoral & Ruynders, 1975: 510; Vachon, 1986: 839; Kovarik, 1995: 189; Lourenço, 1996: 38.

TYPE LOCALITY. Insel Praslin (Seychellen); ZMUH.

TYPE MATERIAL. Republic of Seychelles: Praslin Island, 5.VII.1896, 1FA (lectotype), 1M(im)A (paralectotype No. 1), 8juvsA before first ecdysis (paralectotypes Nos 2–9), 1juv.A after first ecdysis (paralectotype No. 10), 1juv.A after second ecdysis (paralectotype No. 11), leg. A. Brauer, ZMUH.

OTHER MATERIAL. Republic of Seychelles: Praslin Island, 5.VII.1896, 2F7juvsA, leg. A. Brauer, ZMHB No. 10427-8; Mahé Island, 6.III.1899, 1M1FA, Deutsche Tiefsee-Expedition 1898/99, rev. M. Vachon 1979 (No. Va 2471), ZMHB No. 30800.



Figs 2-39. Figs 2-20 and 39 - movable finger of pedipalps. Figs 21-38 - fixed finger of pedipalps. Figs 2, 22 - *Lychas asper* (Pocock), female from BMNH. Fig. 3 - *L. burdoi* (Simon), female from FKCP. Figs 4, 24 - *L. hillyardi* sp. n., male HT. Figs 5, 25 - *L. krati* Kovarik, female HT. Figs 6, 26 - *L. krati* Kovarik, female PT No. 9. Fig. 7 - *L. krati* Kovarik, female PT No. 6, defect. Figs 8, 27 - *L. laevifrons* (Pocock), female from MNHN. Figs 9, 28 - *L. nigristeris*, female from FKCP. Figs 10, 29 - *L. mucronatus* (Fabricius), female HT of *L. mentawaius* Roewer. Figs 11, 30 - *L. mjobergi* Kraepelin, female LT. Figs 12, 31 - *L. mucronatus* (Fabricius), female from FKCP. Figs 13, 32 - *L. nigristeris* (Pocock), female from FKCP. Figs 14, 33 - *L. obsti* Kraepelin, female PLT No. 1. Figs 15, 34 - *L. rackae* sp. n., male HT. Figs 16, 35 - *L. scaber* (Pocock), female from BMNH. Figs 17, 36 - *L. shaplandi* (Oates), female LT. Figs 18, 37 - *L. lourencoi* sp. n., female HT. Figs 19, 38 - *L. variatus* (Thorell), juv. LT of *L. marmoreus kimberleyanus* Kraepelin. Fig. 20 - *L. variatus* (Thorell), female PLT No. 1 of *L. spinatus* Kraepelin. Figs 21, 39 - *L. variatus* (Thorell), female LT of *L. spinatus* Kraepelin. Fig. 23 - *L. burdoi* (Simon), female HT.

DIAGNOSTIC CHARACTERS. Total length 25–36 mm. Sixth cutting edges on movable and fixed fingers of pedipalps without external and internal granules (Fig. 42). Dorsal surface of mesosoma with three conspicuous keels.

First and second metasomal segments with 10 keels, third and fourth segments with eight keels. Ventral surface of seventh mesosomal segment with four conspicuous keels. For position and distribution of trichobothria on pedipalps see Figs 58, 95, and 97. Position of trichobothrium db is variable, in one female (Mahé Island, ZMHB) between trichobothria et and est. Pectinal teeth number 14–18. Further characters include same length of metasoma in both sexes, blotched coloration, and smooth, glossy fifth metasomal segment and telson. Telson markedly prolonged (Kraepelin 1896: fig. 15). For habitus see Lourenço, 1996: fig. 160.

COMMENTS. *L. braueri* differs markedly from other species of *Lychas* in having three keels on the mesosoma, but all other characters place it quite unequivocally in this genus. I am convinced that the species does not require a subgenus of its own because its similarity in habitus with *L. burdoi* is close, although the latter has only one keel on the dorsal surface of the mesosoma.

DISTRIBUTION. Republic of Seychelles: Praslin Island (Kraepelin 1896: 124), Mahé Island (Hirst, 1913: 32).

***Lychas buchari* sp. n.**
(Fig. 108, Tables 1–3)

TYPE LOCALITY. Australia; MNHN.

TYPE MATERIAL. Australia: Australia (locality not known), IFA (holotype), collector not known, MNHN No. RS 4416.

ETYMOLOGY. Named after the Czech arachnologist Jan Buchar of the Charles University, Prague, who has done much for arachnology in the Czech Republic.

DESCRIPTION. The total length of the male holotype is 42.4 mm. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. Pectinal teeth number 26. For the position and distribution of trichobothria on the tibia of pedipalps see Fig. 108.

The base color is uniformly yellow to yellowish brown.

The carapace is without keels but bears large granules.

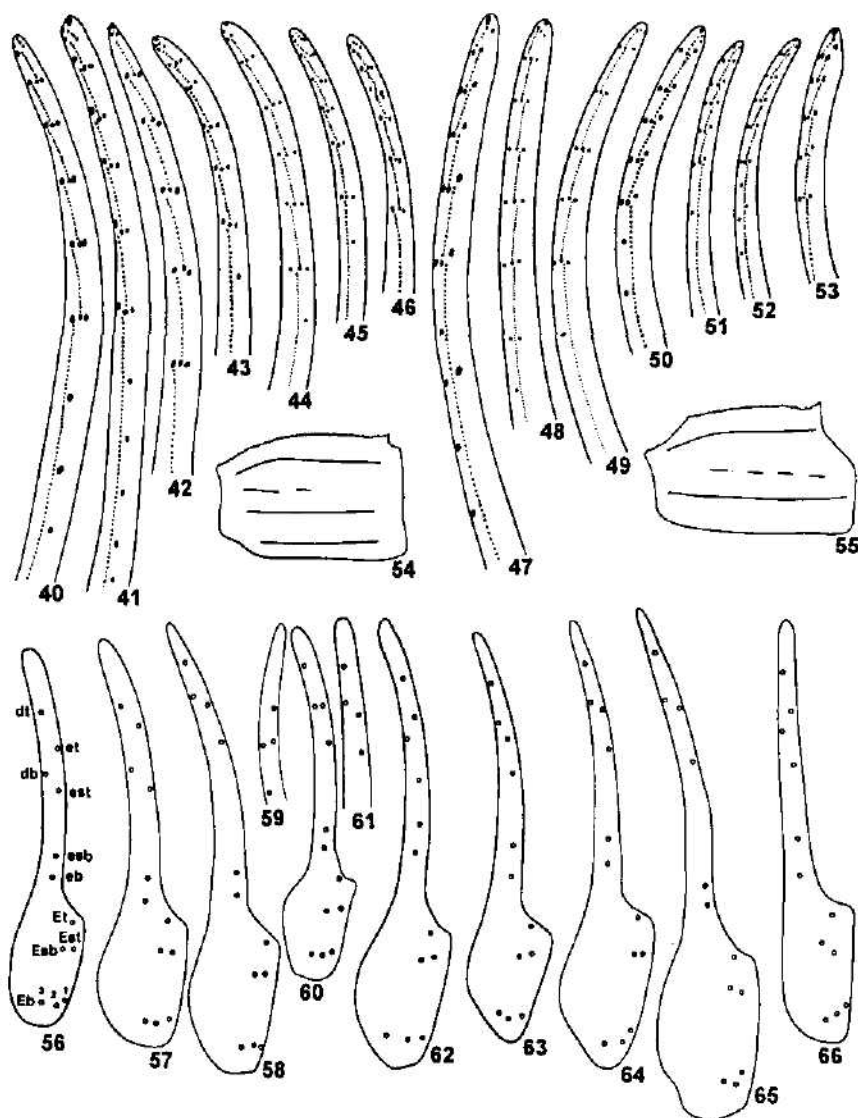
The femur, patella, manus, and fingers of pedipalps are dorsally and laterally uniformly yellow to yellowish brown. The manus of pedipalps has a lobe (Fig. 108). The fingers of pedipalps are not proximally twisted. The sixth cutting edges on the movable and fixed fingers of pedipalps each bear one external granule (Figs 9 and 28).

The mesosoma has an elevated median keel and large granules. The ventral surface of the seventh segment bears four conspicuous keels.

The legs have the same color pattern as the pedipalps.

The metasoma is dominantly yellowish brown, with the anterior parts of the second through fourth segments brown and the anterior three-quarters of the fifth segment black and its posterior quarter yellowish brown. The telson is yellowish brown with a black spot around the subaculear tooth. The first and second segments bear 10 keels; the third and fourth segments bear eight keels, with several granules on the third segment indicating two more keels. All keels on metasomal segments are composed of granules of approximately equal size. The subaculear tooth is terminally rounded, without granules.

AFFINITIES. The described features distinguish *L. buchari* sp. n. from all other species of the genus *Lychas*. They are recounted in the key below.



Figs 40-66. Figs 40-46—movable finger of pedipalps. Figs 47-53—fixed finger of pedipalps. Figs 54-55—third segment of metasoma. Figs 56-66—tibia of pedipalps. Figs 40, 64—*Lychas hosei* (Pocock), female HT. Figs 41, 47—*L. scutillus* C. L. Koch, male from FKCP. Figs 42, 58—*L. braueri* (Kraepelin), female LT. Figs 43, 50—*L. infuscatus* (Pocock), female from MNHN. Fig. 44—*L. marmoreus* (C. L. Koch), female LT of *L. marmoreus splendens* Kraepelin. Figs 45, 51—*L. shelfordi* (Borelli), female from FKCP. Figs 46, 53—*L. tricarinatus* (Simon), female from SMFD. Fig. 48—*L. perfidus* (Keyserling), female LT. Fig. 49—*L. marmoreus* (C. L. Koch), female from BMNH. Figs 52, 62—*L. flavimanus* (Thorell), male from FKCP. Figs 54, 57—*L. asper* (Pocock), female LT of *L. asper obscurus* Kraepelin. Fig. 55—*L. obsti* Kraepelin, female from FKCP. Fig. 56—*L. asper* (Pocock), female from BMNH. Fig. 59—*L. burdoi* (Simon), female HT. Fig. 60—*L. burdoi* (Simon), female from FKCP. Fig. 61—*L. burdoi* (Simon), female HT of *L. burdoi rhodesianus* Lawrence. Fig. 63—*L. hillyardi* sp. n., male HT. Fig. 65—*L. hosei* (Pocock), female LT of *L. tweediei* Kopstein. Fig. 66—*L. krati* Kovarik, female HT.

L. buchari sp. n. is closest to *L. mucronatus*, from which it differs in having only one external granule at the sixth cutting edge on the movable finger of pedipalps. It differs from all other species of the genus *Lychas* in having the highest number of pectinal teeth (Table 3) and a lobe on the manus of pedipalps which is similar to that in some species of the genus *Uroplectes* Peters, 1861.

Table 2. Geographical distribution of *Lychas* species

	Zimbabwe	Zambia	Vietnam	Thailand	Tanzania	Somalia	Seychelles	R. S. A.	Philippines	New Guinea	Nepal	Myanmar	Mozambique	Melanesia	Mauritius	Malaysia	Malawi	Laos	Kenya	Indonesia	India	Congo Rep.	CDR (Zaire)	China	Cambodia	Australia	Angola
<i>L. albimanus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. asper</i>	-	+	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	+	-	-	-	+
<i>L. biharensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. braueri</i>	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. buchari</i> sp. n.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
<i>L. burdoi</i>	-	+	-	-	+	-	-	-	-	-	-	-	+	-	-	-	+	-	-	+	-	-	+	-	-	-	-
<i>L. farkasi</i> sp. n.	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. feae</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. flavimanus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. gravelyi</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	?	-	-	-	-	-	-
<i>L. hendersoni</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. heurtaultae</i> sp. n.	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. hillyardi</i> sp. n.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. hosei</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. infuscatus</i>	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. kamschetensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. kharpadi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. krati</i>	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. laevifrons</i>	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. lourencoi</i> sp. n.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>L. marmoreus</i>	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>L. mjobergi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>L. mucronatus</i>	-	-	-	+	+	-	-	-	+	-	-	+	-	-	+	-	+	+	+	-	+	+	-	+	+	-	-
<i>L. nigristeris</i>	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-
<i>L. obsti</i>	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
<i>L. perfidus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. rackae</i> sp. n.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. rugosus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. scaber</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. scutillus</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. serratus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. shelfordi</i>	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>L. shoplandi</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>L. tricarinatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>L. variatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-

***Lychas burdoi* (Simon, 1882)**
(Figs 3, 23, 59–61, Tables 1–3)

Isometrus burdoi Simon, 1882: 58; Karsch, 1885: 134; Pocock, 1891: 443.
Archisometrus burdoi: Kraepelin, 1891: 222; 1898: 3; Pocock, 1898: 309; 1898: 430; 1898: 500; Kraepelin, 1899: 48; 1901: 267; Strand, 1916: 55.
Lychas burdoi: Purcell, 1902: 173; Hirst, 1911: 4; Kraepelin, 1913: 174; Birula, 1915: 21; 1916: 57; Loveridge, 1925: 307; Werner, 1934: 271; Roewer, 1943: 210; 1952: 28; Geeraerts, 1953: 1065; Lawrence, 1964: 35; Probst, 1972: 6; 1973: 322; Lamoral & Reynders, 1975: 511; Newlands & Martindale, 1980: 69; Lourenço, 1983: 192; Vachon, 1986: 839; Kovarik, 1992: 183; Fitzpatrick, 1994: 23; Kovarik, 1995: 189.
Lychas burdai [sic]: Lönnberg, 1912: 2.
Lychas burdoi burdoi: Birula, 1915: 23.
? = *Lychas burdoi rugulosus* Birula, 1915: 23 nomen nudum.
? = *Lychas burdoi regulosus* Birula, 1916: 60 (TL: Britisch Ost-Afrika, Flusse Guaso-Nyiri); Lamoral & Reynders, 1975: 511; Kovarik, 1995: 189. **Syn. n.**
Lychas burdoi rhodesianus Lawrence, 1938: 290 (TL: South Rhodesia, Chirinda Forest, Silinda Mountain); 1955: 230; Lamoral & Reynders, 1975: 511; Kovarik, 1995: 189. **Syn. n.**

TYPE LOCALITY. Zanzibar; MNHN.

TYPE MATERIAL. **Tanzania:** Afr. Orient., Zanzibar, 1FA (holotype of *Lychas burdoi burdoi*), MNHN No. RS 1480. **Zimbabwe:** Chirinda Forest, Silinda Mountain, 1FA (holotype of *Lychas burdoi rhodesianus*), TMSA No. 8022.

OTHER MATERIAL. **Congo Democratic Republic:** D. O. Africa, Uvira, 1FA, leg. Grauer, ZMHB No. 10453; Uvira-Kivu, Dubois J. Th. (Irsac), 17.X.1957, 1FA, MNHN; Luiswishi, Kipushi, Upper Shaba, 1090 m above sea level, 10.X.1988, 1FA, leg. E. K. Kisimbo, MBCZ No. 496; Ehuirm, 1MA, MNHN No. RS 5040. **Malawi:** Br. Centr. Afr., Blantyre, 25.IX.1904, 2M3FA, leg. K. Fricke, ZMUH. **Mozambique:** 1927, 1FA, leg. Dr. David, NHMB No. 112a; Zambeze, De Chemba env., 1929, 1M1FA, leg. P. Lesne, MNHN No. RS 1484; 2FA, MNHN Nos RS 1458 and 1487. **Tanzania:** Zanzibar, 1M1FA, MNHN No. RS 1478; Kilimanjaro, 3FA, leg. Hoenele, MNHN No. RS 1481; O. Afrika, Tanga, 1FA, SMFD No. RII/6690; Korogwe a/Rufer, 22.IX.1888, 1FA, leg. Stuhlmann, ZMUH; Plantage Lewa, Usambara, 26.IX.1888, 2FA, leg. Stuhlmann, ZMUH; Bagamojo, II.1890, 1M2FA, ZMUH; Dar es Salam, 28.XII.1895, 1M2F1juv.A, leg. Möller, ZMUH; Nyassa, Muya, 1.–9.VI.1898, 1FA, leg. Fülleborn, ZMHB No. 7863; Nyassasee, 1F4juvsA (juvs before first ecdysis), ZMHB No. 8067; Zanguebar, Uruguru, III.1900, 1FA, leg. Leroy, Muséum Paris, ZMUH; D. O. Africa, Pori bei Maliwe Logish Kilva, 7.VI.1908, 1FA, leg. Fraum, ZMHB No. 10478; D. O. Africa, Pori bai, Kuimaburu, 12.VI.1908, 3M3F14juvsA (juvs before first ecdysis), ZMHB No. 10450; D. O. Africa, Morogoro, 7.VII.1909, 1MA, 18.IX.1909, 1M1FA, leg. Reuss, ZMHB Nos 10440 and 10434; D. O. Africa, Mikindani, 1910, 1M2F1juv.A, X.1910, 1FA, leg. Grote, ZMHB Nos 10429 and 10454; D. O. Africa, Moschi near Massai, XII.1911, 1FA, ZMHB No. 10439; Dar es Salam, 25.III.1911, 1M1FA, leg. Eichelbaum, ZMUH; D. O. Africa, Dar es Salam, 5.–6.I.1912, 1M5FA, ZMHB No. 10431; D. O. Africa, Dar es Salam, near Tuguberger, 1M5FA, leg. Heinrist, ZMHB No. 10430; D. O. Africa, Dar es Salam, 2FA, ZMHB No. 10458; D. O. Africa, Golugolo, 1.–9.XI.1912, 1FA, ZMHB No. 10438; D. O. Africa, Kilimandscharo, 3000–2500 m, II.1912, 1juv.A, leg. Schröder, ZMHB No. 10481; Kilimandscharo, 1912, 1FA, ZMHB; D. O. Africa, Mikindani, X.1916, 1M1FA, leg. Grote, ZMHB No. 10479; Kilimanjaro, Mrongu, Kufurand, 1500 m, 1929, 1FA, leg. O. Raum, ZMUH; D. O. Africa, Mlalo, 2M3FA (one male is immature), leg. Pastor K. Röhl, ZMHB No. 10432; D. O. Africa, Songea, 1M3FA, leg. Philipps, ZMHB No. 10452; D. O. Africa, Mpanda, St. glanning, 1FA, ZMHB No. 10470; Bagamoyo, 7.V.1957, 4FA, leg. Schweinitz, ZMHB No. 7557; Zanzibar, 1M2FA, leg. Fischer, ZMHB No. 4100; Mujiji, Hosemann, 1FA, ZMHB No. 10472; Kasoje camp, 16.–29.VII.1959, 1M3FA, coll. I. A. C., 2nd O. U. Tanganyika Exp., MNHN; Pasagulu camp, 5.VIII.1959, 1MA, coll. R. H., 2nd O. U. Tanganyika Exp., MNHN No. 202; Kasage, 1FA, MNHN No. CO 51; Kasage, 22.VIII.1959, 1FA, MNHN No. CO 52; 1M1FE, det. 1990, NMPC; 2FE, det. 1987, FKCP; Utete-Rufiji, Kindwiwi, 10.–14.XII.1993, 2M1FE, leg. M. Snižek, FKCP. ? **Tanzania:** O. Afrika, 1FA, leg. Knippes, SMFD; 28.III.1897, 2M1FA, ZMHB No. 10451; D. Ostafrika, 10.VI.1898, 1FA, leg. Stierling, ZMUH; D. O. Africa, Langenburg, 17.IV.1898, 3FA, No. 10477, V.–X.1898, 2MA, No. 7865, V.–X.1898, 1juv.A, No. 10446, V.–X.1898, 1juv.A, No. 10496, 21.X.1898, 1M3FA, No. 7862, 23.XII.1898, 1M3FA, No. 10459, 1898, 1FA, No. 10475, III.–IV.1899, 1FA, No. 10474, 25.VIII.1899, 1MA, No. 10443, XII.1899, 1FA, No. 10480, 1899, 1FA, No. 7864, 1899, 1MA, No. 10447, 1899, 1FA, No. 10448, leg. Fülleborn, ZMHB; D. O. Africa, 12.VI.1898, 3M1FA, leg. Froncen, ZMHB No. 10457; D. O. Africa, Sangara, 4.III.1907, 1FA, leg. Förster, ZMHB No. 10437; D. O. Africa, Lidenge, 8.VII.1908, 1FA, leg. Framen, ZMHB No. 10473; D. O. Africa, Tendaguru, VI.1912, 1juv.A, leg. Reck, ZMHB No. 10442; D. O. Africa, Kapions am Malamou Bez Kilma, 1juv.A, ZMHB No. 10497; D. O. Africa, Bezirksnebeustelle Kibata, 1FA, leg. Gouvernement, ZMHB No. 10436; D. O. Africa, Mahenge-Bezirk, 2M4FA, ZMHB No. 10433; D. O. Africa, 4M5F1juv.A, leg. Regner, ZMHB No. 10449; D. O. Africa, 1FA, leg. Beangel, ZMHB No. 10444; D. O. Africa, 1FA, leg. Dempwolf, ZMHB No. 10441; D. O. Africa, Vossalor, 1FA, ZMHB No. 10455; O. Afrika, 1MA, leg. Tiesler,

ZMHB No. 10495; O. Afrika, 1FA, leg. Götze, ZMHB No. 10476; Neu Uelgolano, 1899, 2FA, ZMHB No. 10456; Langubs, 1899, 1FA, leg. Füllborn, ZMHB No. 10445; Station Morobe, 1F15juvsA (before first ecdysis), ZMHB No. 10435; Volkeno, 1FA, ZMHB No. 7634; 1FA, ZMHB No. 10460; Ijuv.A, ZMHB No. 10471; Afrika, 2FA, ZMHB No. 7009; Ost Africa, Tundunu, 2.X.1926, 1MA, leg. Brandes, ZMHB No. 2610/27. **Zambia:** N. W. Rhodesia, Broken Hill, 20.IV.1911, 1FA, leg. P. Timm, ZMUH.?: 1MA, MNHN No. RS 1485.

DIAGNOSTIC CHARACTERS. Total length 25–40 mm, males usually smaller than females. Sixth cutting edges on movable and fixed fingers of pedipalps without external and internal granules (Figs 3 and 23). First metasomal segment has 10 keels, second segment may have eight but also 10 keels, and third and fourth segments have eight keels. Lower surface of seventh segment without keels. For position and distribution of trichobothria on tibia of pedipalps see Figs 59–61. Position of trichobothrium db is variable (Figs 59–61). Habitus is shown in Fig. 1. Pectinal teeth number 13–18.

COMMENTS. The holotype of *L. burdoi burdoi* lacks the entire right pedipalp. Simon (1882) did not clearly mark the type, and the possibility that his description is based on another specimen thus cannot be excluded. Simon (1882: 58–59) gave a total length of 25 mm and 16–18 pectinal teeth. The holotype examined by me has a total length of 32.5 mm and 15–16 pectinal teeth (Table 1).

The long preservation in alcohol obliterated the color of the holotype. In live specimens the legs and the femur of pedipalps are spotted, the patella is mostly dark, and the manus is light in comparison with the reddish-brown fingers, telson, and much of the fifth segment of the metasoma.

Upon examination of the holotype of *L. burdoi rhodesianus* (total length 35.7 mm) I conclude that it does not differ from the nominotypical subspecies *L. burdoi burdoi*. It is a female which Lawrence (1938) mistook for a male.

The holotype of *L. burdoi regulosus* is said to be deposited at the Zoological Institute of Russian Academy of Sciences, St. Petersburg, but cannot be located and may have been permanently lost. Since Birula's description (1916) does not contain truly diagnostic characters and the available literature does not mention any other specimens, I believe this subspecies to be most likely invalid.

DISTRIBUTION. Congo Democratic Republic (former Zaire) (Roewer 1952: 28), Kenya (Pocock 1891: 445), Malawi (Pocock 1898: 430), Mozambique (Birula 1916: 51), Republic of South Africa (Lawrence 1964: 35), Tanzania (Simon 1882: 58), Zambia (Hirst 1911: 4), and Zimbabwe (Lawrence 1938: 290).

Lychas farkasi sp. n.

(Fig. 122, Tables 1–3)

TYPE LOCALITY. Nepal, Kotzoli; MNHN.

TYPE MATERIAL. Nepal: Kotzoli, 25.XII.1966, 1MA (holotype), leg. M. Hubert, MNHN No. RS 8225.

ETYMOLOGY. Named after Balázs Farkas of the Hungarian Natural History Museum, Budapest, Hungary.

DESCRIPTION. The total length is 41.4 mm in the male holotype. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. Pectinal teeth number 25. For the position and distribution of trichobothria on the tibia of pedipalps see Fig. 122.

The base color is uniformly yellow to yellowish brown (long preservation in alcohol).

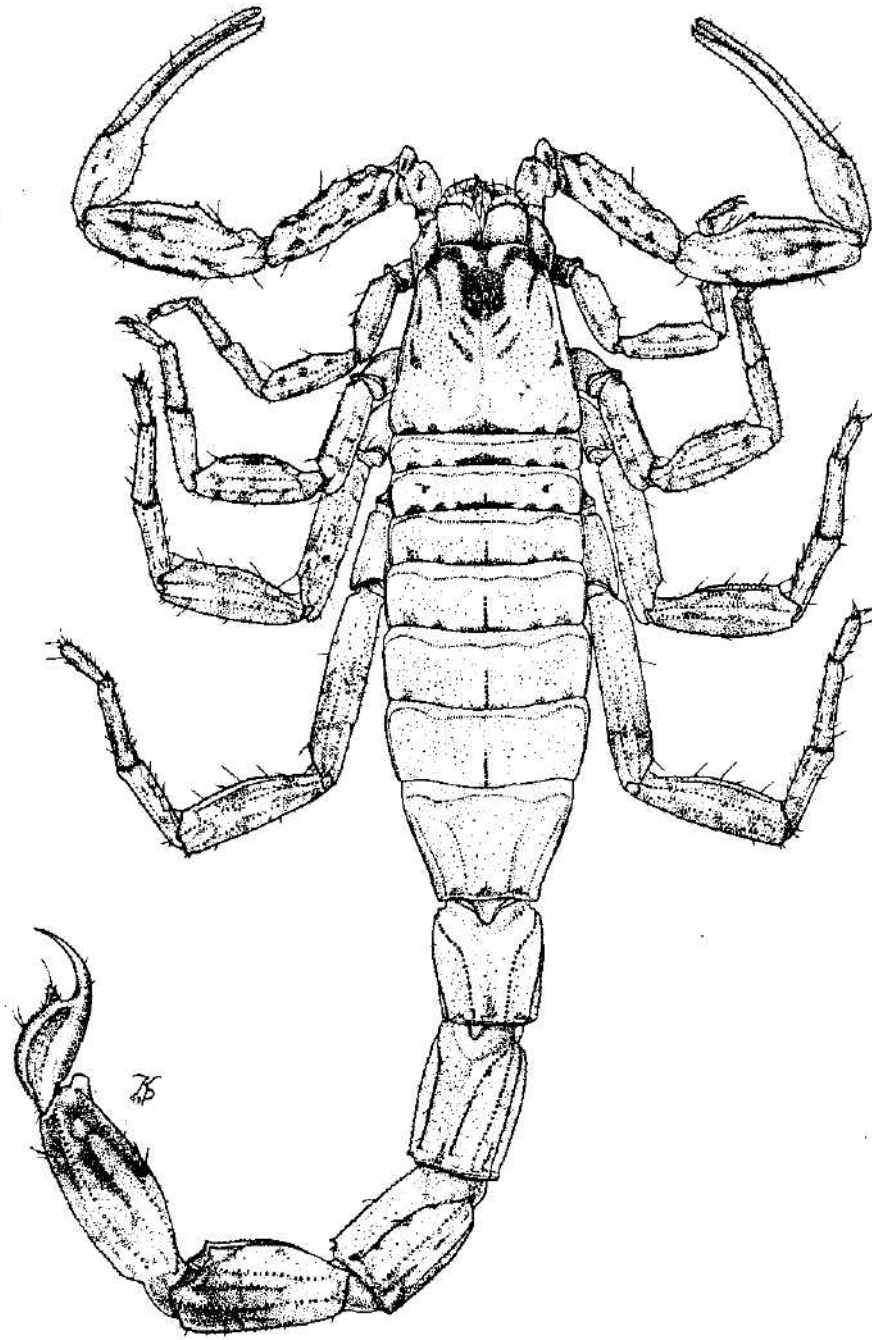


Fig. 67 – *Lychas hillyardi* sp. n., male HT. Dorsal aspect.

The carapace and manus of pedipalps are without keels but with numerous large granules. The sixth cutting edges on the movable fingers of pedipalps lack external and internal granules (Fig. 17). Fingers of pedipalps are proximally somewhat twisted (Fig. 122).

The mesosoma bears three median keels and large granules. The lower surface of the seventh segment bears four keels and large granules.

Tibial spurs on the third and fourth legs are markedly long.

The metasoma bears large granules. The first through third metasomal segments bear 10 keels, and the fourth segment bears eight keels. The subaculear tooth is pronounced, with granules.

AFFINITIES. The described features distinguish *L. farkasi* sp. n. from all other species of the genus *Lychas*. They are recounted in the key below.

L. farkasi sp. n. differs from *L. feae* (Myanmar, not included in the key) in the color of the manus of pedipalps, carapace, terga, and legs, which are black in *L. feae* (Pocock 1900: 42).

L. farkasi sp. n. is close to *L. tricarinatus*, from which it differs in having the manus of pedipalps granulated.

***Lychas feae* (Thorell, 1889)**

(Tables 2–3)

Isometrus feae Thorell, 1889: 569.

Isometrus feae [sic]: Pocock, 1893: 296.

Archisometrus feae: Kraepelin, 1895: 85; 1899: 51.

Lychas feae: Pocock, 1900: 42; Kraepelin, 1913: 133; Takashima, 1945: 83; L. E. Koch, 1977: 124; Vachon, 1982: 86; 1986: 839; Kovarik, 1995: 189.

TYPE LOCALITY. Shwegoo; MCSN.

DIAGNOSTIC CHARACTERS. Total length 26 mm in holotype (female, possibly immature) (Thorell 1889: 570). Sixth cutting edge on movable finger of pedipalps without external and internal granules (Kraepelin 1913: 133). First through third metasomal segments with 10 keels, but two keels on third segment weakly developed (Thorell 1889: 569 and 571). Pectinal teeth number 17–20 (Thorell 1889: 570), but Kraepelin counted 20–23 (Kraepelin 1913: 133). Fingers of tibia of pedipalps are light-colored and manus of tibia is dark (Thorell 1889: 573).

COMMENTS. The species is based on a female (possibly immature) obtained by Mr. Fea (Thorell 1889: 573). Unfortunately, I have not been able to examine the types or any other specimens of this species, and the diagnostic characters are therefore based solely on the authors cited.

Examination of the holotypes is needed, because it is possible that *L. feae* is a synonym of *L. shoplanti* (Oates, 1888). Kraepelin (1913: 133) differentiated these two species by the number of keels on mesosomal segments, with *L. shoplanti* having three keels and *L. feae* having only one keel. I examined the type specimens of *L. shoplanti* from Myanmar and designated a lectotype. *L. shoplanti* has mesosomal segments with only one dorsal keel.

Unfortunately, the MCSN holotype of *L. feae* has not yet been found. Because of insufficient published data, I am unable to include this species in the key below.

DISTRIBUTION. Myanmar (Thorell 1889: 573).

***Lychas flavimanus* (Thorell, 1888)**

(Figs 52, 62, Tables 1–3)

Isometrus flavimanus Thorell, 1888: 409; Pocock, 1894: 87.

Archisometrus flavimanus: Kraepelin, 1891: 222; 1895: 85; 1899: 45 (in part).

Lychas flavimanus: Kopstein, 1921: 122; 1923: 186; Banks, 1928: 505; Giltay, 1931: 18; Kopstein, 1937: 176; Takashima, 1945: 78; L. E. Koch, 1977: 124; Vachon & Lourenço, 1985: 9; Vachon, 1986: 839; Kovafik, 1995: 189.

TYPE LOCALITY. Sumatra, Aer Mancior; MCSN.

TYPE MATERIAL. **Indonesia:** Sumatra, Ajer Mant eior, 1878, IMA (holotype), leg. O. Beccari, MCSN.

OTHER MATERIAL. **Indonesia:** Sumatra, Padang, 5.XII.1899, IFA, ZMUH; Sumatra, V.1980, IMA (im), FKCP.

DIAGNOSTIC CHARACTERS. Total length 33 mm in an immature male holotype and 42 mm in an adult female (Pocock 1894: 87). Sixth cutting edge on movable finger of pedipalps with three external granules (Fig. 40 and Pocock 1894: pl. 6, fig. 2a). Fixed finger with three external granules and one internal granule (Fig. 52). First metasomal segment with 10 keels, second through fourth segments with eight keels. For position and distribution of trichobothria on tibia (Fig. 62), patella, and femur of pedipalps see Vachon 1986: 846, figs 15–21. Pectinal teeth number 15–19.

Mesosoma, femur, and patella of pedipalps and legs are dark brown. Tibia and tarsomeres of legs, telson, and manus of pedipalps are pale yellow. Fingers of pedipalps are dark brown to black. Segments of metasoma are anteriorly brown and posteriorly dark brown. Legs may be variegated. For habitus of male see Pocock, 1897: pl. 6, fig. 2.

COMMENTS. The species is based on an examined immature male with 19 pectinal teeth. Pocock (1894: 87) included three specimens (two adult females and one juvenile) from Sinkarah, Sumatra, with 15–17 pectinal teeth. Kraepelin (1899: 45) concluded that this species has 15–21 pectinal teeth, but at the same time incorrectly placed *L. hosei* in its synonymy.

DISTRIBUTION. **Indonesia:** Sumatra (Thorell 1888: 412), Borneo (Kopstein 1921: 122), and Malaysia: Sarawak (Banks 1928: 505).

Lychas gravelyi Henderson, 1913 (Tables 2–3)

Lychas gravelyi Henderson, 1913: 129; Takashima, 1945: 84; L. E. Koch, 1977: 124; Kovafik, 1995: 189.

Lychas (*Distotrichus*) *gravelyi*: Tikader & Bastawade, 1983: 48; Bastawade, 1986: 637.

Lychas rugosus: Kraepelin, 1913: 133 (in part).

TYPE LOCALITY. Tenasserim, Moulmein; NZSI.

DIAGNOSTIC CHARACTERS. Total length of female holotype 34 mm (Henderson 1913: 130). Sixth cutting edge on movable finger of pedipalps with one external granule (Tikader & Bastawade 1983: 49, fig. 119). First and second metasomal segments with 10 keels, third and fourth segments with eight keels (Henderson 1913: 129; Kraepelin 1913: 133). For position and distribution of trichobothria on tibia, patella, and femur of pedipalps see Tikader & Bastawade 1983: 51, figs 125–129. Pectinal teeth number 12–13 (Henderson 1913: 130; Tikader & Bastawade 1983: 50). Color pattern spotted. Patella and femur of pedipalps predominantly dark, with but a few light spots. Fingers of tibia of pedipalps dark and manus of tibia light (Henderson 1913: 130, fig. 3). Tibial spurs short (Henderson 1913: 129).

COMMENTS. The species is based on a single female obtained by F. H. Gravely (Henderson 1913: 129). Kraepelin (1913: 133) believed *L. gravelyi* to be a synonym of *L. rugosus*. Unfortunately, I have not been able to examine the types or any other specimens of this species, and the diagnostic characters are therefore based solely on the authors cited.

DISTRIBUTION. Myanmar (Henderson, 1913: 129). Tikader & Bastawade (1983: 53) thought that this species might occur also in India.

***Lychas hendersoni* (Pocock, 1897)**
(Fig. 116, Tables 1–3)

Archisometrus hendersoni Pocock, 1897: 111; Kraepelin, 1899: 51.

Lychas hendersoni: Pocock, 1900: 40; Kraepelin, 1913: 133; Henderson, 1919: 380; Takashima, 1945: 84; L. E. Koch, 1977: 124; Kovarik, 1995: 189.

Lychas (Alterotrichus) hendersoni: Tikader & Bastawade, 1983: 66; Bastawade, 1986: 637.

TYPE LOCALITY. India, Yercaud in the Sheveroy Hills; BMNH.

TYPE MATERIAL. India: Yercaud in the Sheveroy Hills, 1894, 1FA (holotype), leg. J. R. Henderson, BMNH No. 1894.10.24.38–41.

DIAGNOSTIC CHARACTERS. Total length of female holotype 34 mm (Pocock 1897: 112). Sixth cutting edges on movable and fixed fingers of pedipalps without external and internal granules (Figs 8, 27, and Tikader & Bastawade 1983: 67, 70, figs 174 and 184). First through third metasomal segments with 10 keels. For position and distribution of trichobothria on tibia, patella, and femur of pedipalps see Fig. 116 and Tikader & Bastawade 1983: 70, figs 179–184. Pectinal teeth number 17–18. Color uniform. Pedipalps entirely yellow to yellowish brown (Pocock 1897: 111; Tikader & Bastawade 1983: 67, figs 170 and 174). For habitus see Tikader & Bastawade 1983: 67, fig. 170.

COMMENTS. The species is based on a single female obtained by J. R. Henderson (Pocock 1897: 112). According to Pocock the color is variegated, but due to long preservation in alcohol it is now reddish brown.

DISTRIBUTION. India (Pocock 1897: 112).

***Lychas heurtaultae* sp. n.**
(Fig. 123, Tables 1–3)

TYPE LOCALITY. Nepal, Kabre Kirantichap, Charanga-Khola, Zarangje-Khola; MNHN.

TYPE MATERIAL. Nepal: Kabre Kirantichap, Charanga-Khola, Zarangje-Khola, 1000–1160 m, 19.VI.1956, IMA (holotype) 1FA (allotype), leg. H. Janetscher, Nos RS 8226 and 8229. Holotype in MNHN, allotype in NMPC.

ETYMOLOGY. Named after the French arachnologist Jacqueline Heurtault, curator at the Muséum national d'Histoire naturelle, Paris, France.

DESCRIPTION. The total length is 37.1 mm in the male holotype and 41.4 mm in the female allotype. The habitus is shown in Fig. 123. The male differs from female in having longer and narrower metasomal segments. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. Pectinal teeth number 23–24 in the male and 21 in the female. For the position and distribution of trichobothria on the tibia of pedipalps see Fig. 85.

The base color is dark brown, with yellow spots.

The chelicera is reticulated.

The carapace is without keels but with large granules. The triangle between median eyes and anterior margin of carapace is glossy and smooth (female) or tuberculate, without granules which cover other areas of carapace (male).

The patella and tibia of pedipalps are dark brown, dorsally and laterally with sparse yellow spots. The ventral surface of the patella of pedipalps is yellow, without spots. The fingers are yellow or yellowish brown. The femur of pedipalps is black in the male and yellow with sparse minute dark brown spots in the female. The sixth cutting edges on the movable fingers of pedipalps lack external and internal granules (Fig. 17).

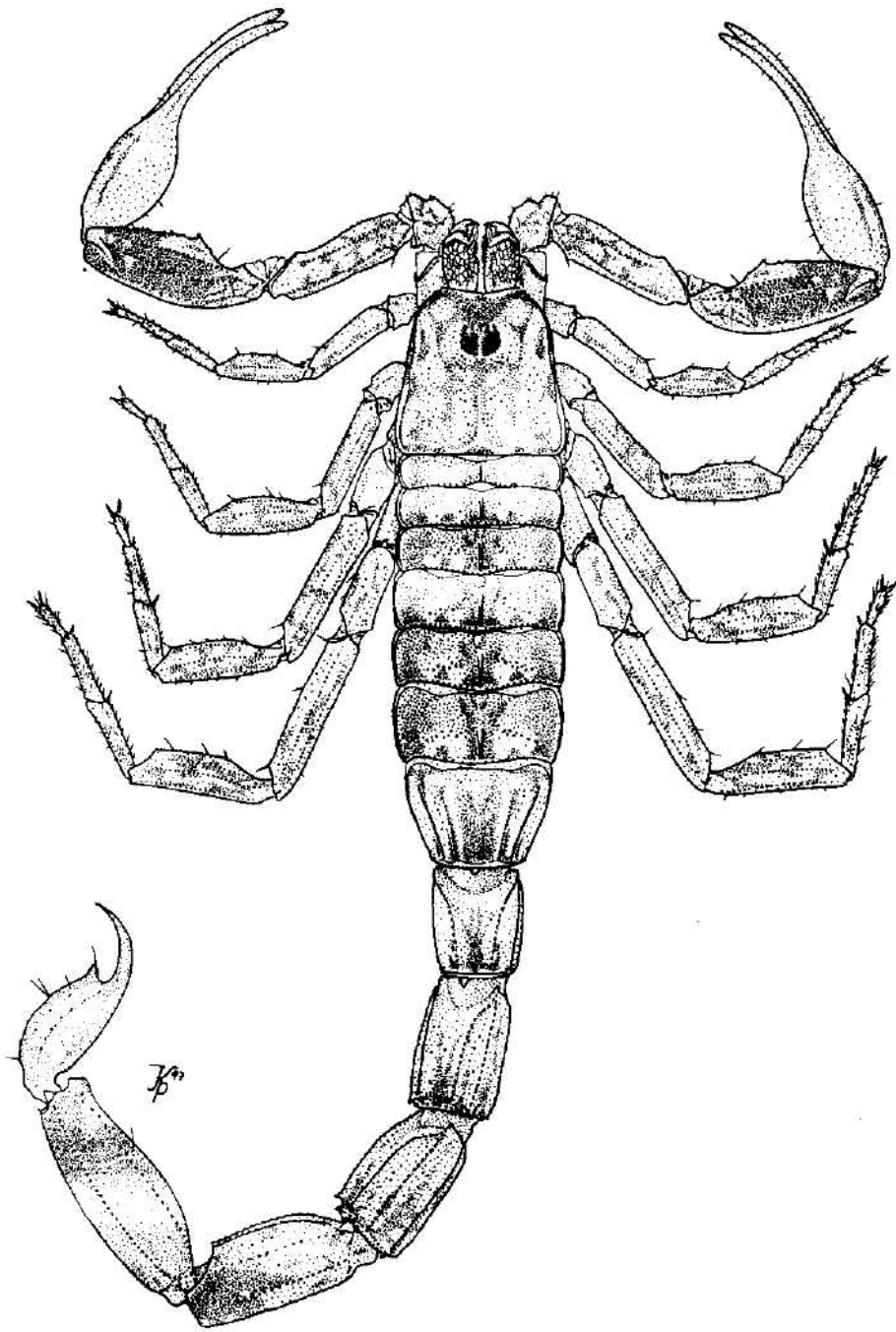


Fig. 68 – *Lychas rackae* sp. n., male HT. Dorsal aspect.

The mesosoma is dark brown with sparse yellow spots, and bears one pronounced median keel and large granules. The lower surface of the seventh segment bears four keels.

The legs have the same color pattern as the patella of pedipalps. Tibial spurs on the third and fourth legs are markedly long.

The metasoma is dark brown, with sparse yellowish brown spots. There are 10 keels on the first and second segments and eight keels on the third and fourth segments. The subaculear tooth is pronounced, pointed, with one row composed of two granules in the upper midline.

AFFINITIES. The described features distinguish *L. heurtaultae* sp. n. from all other species of the genus *Lychas*. They are recounted in the key below.

L. heurtaultae sp. n. differs from *L. feae* (Myanmar, not included in the key) in having eight keels on the third metasomal segment. *L. feae* has 10 keels on the third metasomal segment (Thorell 1889: 569).

L. heurtaultae sp. n. is close to *L. laevifrons* and *L. shoplanti*, but the former has yellow manus and patella of pedipalps, and the latter has 10 keels on the third metasomal segment.

***Lychas hillyardi* sp. n.**
(Figs 4, 24, 63, 67, Tables 1–3)

TYPE LOCALITY. India, Kashmir, Kistwar; FKCP.

TYPE MATERIAL. India: Kashmir, Kistwar, 24.VII.1992, IME (holotype), FKCP.

ETYMOLOGY. Named after Paul D. Hillyard, curator at the British Museum (Natural History), London, in appreciation of his kind help.

DESCRIPTION. The total length of the male holotype is 28.1 mm. The habitus is shown in Fig. 67. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. There are 16–17 pectinal teeth in the holotype. For the position and distribution of trichobothria on the tibia of the pedipalps see Fig. 63.

The base color is yellow, with brown spots.

The chelicera is reticulated in the front only.

The carapace is without keels but with large granules. It is more intensely yellow, with small and sparse black spots. There is a black spot around the median eyes.

The femur, patella, and manus of the pedipalps are dorsally and laterally yellow with brown spots. The ventral surfaces of femur, patella, and tibia of pedipalps are yellow without spots. The fingers are yellow. The sixth cutting edges on the movable and fixed fingers of pedipalps bear one external granule each (Figs 4 and 24).

The mesosoma bears one median keel and is yellow, with a row of five or six black spots on the posterior margins of the tergites. The lower surface of the seventh segment bears two keels and is smooth, without any granules.

The legs have the same color and patterns as the femur, patella, and tibia of pedipalps.

The metasoma is also spotted. The first through third segments bear but a few black spots, on the fourth segment black spotting increases toward the posterior margin, and on the fifth segment (except for the anterior margin) and on the entire telson black color dominates. The first segment bears 10 keels, the second through fourth segments bear eight keels. The dorsal keels on the metasoma terminate in a conspicuous tooth that is especially pronounced on the second and third segments. The subaculear tooth is pronounced and pointed, with one row composed of two granules in the upper midline.

AFFINITIES. The described features distinguish *L. hillyardi* sp. n. from all other species of the genus. They are recounted in the key below.

L. hillyardi sp. n. differs from *L. feae* (Myanmar, not included in the key) in the color of the manus of pedipalps, carapace, terga, and legs, which are black in *L. feae* (Pocock 1900: 42).

***Lychas hosei* (Pocock, 1891)**
(Figs 40, 64, 65, 92, Tables 1–3)

Isometrus hosei Pocock, 1891: 436; 1894: 87.

Archisometrus hosei: Kraepelin, 1895: 85.

Lychas hosei: Vachon & Lourenço, 1985: 9; Vachon, 1986: 839; Kovarik, 1994: 197; 1995: 189.

Archisometrus flavimanus: Kraepelin, 1899: 45 (in part).

Lychas tweediei Kopstein, 1937: 175 (TL: Malay Peninsula, Pahang near Bentong, Bukit Chintamani); Takashima, 1945: 79; Vachon, 1986: 839; L. E. Koch, 1977: 124; Kovarik, 1995: 190. *Syn. n.*

TYPE LOCALITY. Baram in Borneo; BMNH.

TYPE MATERIAL. **Malaysia:** Sarawak, Baram, 1FA (holotype), leg. Ch. Hose, BMNH No. 1891.3.30.20; Pahang, Caya in Chintamani Hill near Bentong, VIII. 1935, 1FA (lectotype of *Lychas tweediei*), BMNH.

OTHER MATERIAL. **Malaysia:** Malacca, I–III. 1909, 1FA, leg. Jachan (labeled: "*Lychas nigrimanus*"), rev. M. Vachon 1981–82 No. VA 2618, ZMHB No. 11350; Sarawak, Niah Greath Cave, 22.V.1978, 1F3juvsA, leg. P. Chapman, MNHN No. RS 8491; Sarawak, Water polo Cave, Gunang Api, 18.12.1980, 1FA, leg. P. Chapman, MNHN No. RS 8175; 2FA, FKCP.

DIAGNOSTIC CHARACTERS. Total length 62–69 mm (known only for females). Sixth cutting edges on movable and fixed fingers of pedipalps with three external granules and one or no internal granule each (Figs 31 and 40). First metasomal segment bears 10 keels, second through fourth segments bear eight keels. For position and distribution of trichobothria on tibia and patella of pedipalps see Figs 64, 65, and 92. Subaculear tooth is pointed, with two conspicuous medial granules. Color is uniform black, only tibia of pedipalps and telson are yellow and tibia and tarsomeres of legs are yellowish brown. This color pattern is apparent in immature specimens as well. Pectinal teeth number 18–24. For habitus see Pocock 1891: pl. 2, fig. 2.

COMMENTS. The species is based on a single specimen (Pocock 1891: 437). Kraepelin (1899) regarded *L. hosei* as a synonym of *L. flavimanus*, but Vachon & Lourenço (1985: 10) studied both holotypes and declared *L. hosei* a separate species. Pocock (1894: 87) distinguished *L. hosei* from *L. flavimanus* also on the four ventral keels of the seventh mesosomal segment, which according to him are conspicuous in *L. hosei* and nearly obsolete in *L. flavimanus*; however, examined specimens of both species show this character to be variable. I consider the position of trichobothrium db (Figs 62 and 64) and number of pectinal teeth (Table 3) the best characters for differentiating between these two species.

I have examined and designated the lectotype of *L. tweediei* (Fig. 65), and am certain that it is a synonym of *L. hosei*. Kopstein (1937: 176) distinguished *L. tweediei* on color only from *L. flavimanus*, presumably because data published by Kraepelin convinced him that *L. hosei* is not a valid species.

DISTRIBUTION. Malaysia: Sarawak (Pocock 1891: 437), Malay Peninsula (Kopstein 1937: 175).

Table 3. Number of pectinal teeth in *Lychas* species.

Explanatory notes: M – male, F – female, J – juvenile (includes only juves whose sex cannot be determined), x – number of pectinal teeth given by other authors, not from specimens examined in this study. Each pecten is considered a unit. Where both pectens are complete, they are counted twice. In contrast, pectens which are obviously abnormal or incomplete are not included. Omitted is *L. serratus* from Mauritius, in which the number of pectinal teeth is not known

		number teeth in pecten																number of specimens			
		8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		24	25	26
<i>L. abimanius</i>		—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—
<i>L. asper</i>	M	—	—	—	—	—	1	10	18	11	7	6	—	—	—	—	—	—	—	—	28
	F	—	—	—	—	2	18	74	38	15	17	1	2	—	—	—	—	—	—	—	86
	J	—	—	—	—	—	1	2	2	1	—	—	—	—	—	—	—	—	—	—	3
<i>L. biharensis</i>		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—
<i>L. braueri</i>	M	—	—	—	—	—	—	—	—	2	2	—	—	—	—	—	—	—	—	—	2
	F	—	—	—	—	—	—	2	1	2	3	—	—	—	—	—	—	—	—	—	4
	J	—	—	—	—	—	—	2	7	9	7	1	—	—	—	—	—	—	—	—	13
<i>L. buchani</i> sp. n.	M	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	1
<i>L. burdoi</i>	M	—	—	—	—	—	—	2	23	39	28	1	—	—	—	—	—	—	—	—	47
	F	—	—	—	—	—	1	32	77	89	25	2	—	—	—	—	—	—	—	—	118
	J	—	—	—	—	—	—	—	3	8	2	—	—	—	—	—	—	—	—	—	7
<i>L. farkasi</i> sp. n.	M	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	1
<i>L. fesse</i>		—	—	—	—	—	—	—	—	—	x	x	x	x	?	?	?	—	—	—	—
<i>L. flavimanus</i>	M	—	—	—	—	—	—	1	1	x	—	2	—	—	—	—	—	—	—	—	2
	F	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	1
<i>L. graveleyi</i>		—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>L. hendersoni</i>	F	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	1
<i>L. heurtautae</i> sp. n.	M	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	1
	F	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	1
<i>L. hillyardi</i> sp. n.	M	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	1
<i>L. hosei</i>	M	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	—	—	2
	F	—	—	—	—	—	—	—	—	—	—	2	3	4	2	2	3	—	—	—	8
<i>L. infuscatus</i>	F	1	1	4	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
<i>L. kamschatkensis</i>		—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—
<i>L. kharpedi</i>		—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—
<i>L. krali</i>	M	—	—	—	—	—	—	1	—	1	1	2	—	—	—	—	—	—	—	—	3
	F	—	—	—	—	—	—	3	10	13	6	2	—	—	—	—	—	—	—	—	17
<i>L. laevifrons</i>	F	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	20	8	1	—	18
<i>L. laurenci</i> sp. n.	F	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
<i>L. marmoratus</i>	M	—	—	—	—	—	—	x	10	17	6	2	x	x	x	x	—	—	—	—	18
	F	—	—	—	—	6	15	17	15	5	x	x	—	—	—	—	—	—	—	—	30
	J	—	—	—	—	1	2	2	3	—	—	—	—	—	—	—	—	—	—	—	4
<i>L. mjobergi</i>	F	—	—	—	—	—	—	—	—	—	—	—	—	—	2	x	—	—	—	—	1
<i>L. mucronatus</i>	M	—	—	—	—	—	—	—	—	—	—	3	6	30	75	95	23	13	—	2	133
	F	—	—	—	—	—	—	—	—	3	3	15	82	197	178	74	14	3	1	—	295
	J	—	—	—	—	—	—	—	—	—	—	2	15	21	31	20	6	2	—	—	52
<i>L. nigristeris</i>	M	—	—	—	—	—	—	1	4	—	—	—	—	—	—	—	—	—	—	—	3
	F	—	—	—	—	—	—	2	11	13	9	—	—	—	—	—	—	—	—	—	18
	J	—	—	—	—	—	—	1	1	3	4	1	—	—	—	—	—	—	—	—	5
<i>L. obsti</i>	M	—	—	—	—	—	—	—	—	2	6	—	—	—	—	—	—	—	—	—	4
	F	—	—	—	—	—	—	—	—	3	6	5	7	2	—	—	—	—	—	—	12
	J	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	1
<i>L. perfidus</i>	M	—	—	—	1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
	F	—	—	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
<i>L. rackee</i> sp. n.	M	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	1
<i>L. rugosus</i>	M	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
<i>L. scaber</i>	M	—	—	—	—	—	—	—	—	—	—	1	2	1	—	—	—	—	—	—	2
	F	—	—	—	—	—	—	—	—	—	x	1	1	—	—	—	—	—	—	—	1
<i>L. scutellus</i>	M	—	—	—	—	—	—	—	2	5	21	16	4	—	—	—	—	—	—	—	24
	F	—	—	—	—	—	—	6	20	28	10	3	—	—	—	—	—	—	—	—	36
	J	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	2
<i>L. shelfordi</i>	M	—	—	—	2	9	3	4	—	—	—	—	—	—	—	—	—	—	—	—	9
	F	—	—	1	4	14	5	—	—	—	—	—	—	—	—	—	—	—	—	—	12
	J	—	—	—	3	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
<i>L. shoplandi</i>	F	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	x	x	—	1
	J	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	3	—	—	—	4
<i>L. tricarinatus</i>	M	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	1
	F	—	—	—	—	—	—	—	—	—	—	—	—	4	6	9	11	9	4	1	22
<i>L. variatus</i>	M	—	—	—	—	x	1	3	2	1	1	2	x	x	1	1	x	x	—	—	6
	F	—	—	2	6	8	6	7	1	3	4	2	5	1	x	x	x	x	—	—	23
	J	—	—	—	1	2	5	2	1	3	—	—	—	—	—	—	—	—	—	—	7

***Lychas infuscatus* (Pocock, 1891)**
(Figs 43, 50, 69, 103, Tables 1–3)

Isometrus infuscatus Pocock, 1891: 438.

Archisometrus infuscatus: Kraepelin, 1895: 85; 1899: 47; 1901: 268.

Lychas infuscatus: Takashima, 1945: 80; L. E. Koch, 1977: 124; Vachon, 1986: 839; Kovařík, 1995: 189.

? *Archisometrus* cf. *asper*: Kraepelin, 1901: 268.

TYPE LOCALITY. Philippine Islands; BMNH

MATERIAL. **Philippines**: Manila, 2FA, MNHN No. RS 1443 and 1490; Manila env., III.1979, 2FA, leg. P. Dorsak, FKCP; IFA, ZMUH No. EK 3954.

DIAGNOSTIC CHARACTERS. Total length 32.8–36.5 mm. Sixth cutting edge on movable fingers of pedipalps with one external granule (Fig. 43) and on fixed fingers with two external granules and one or no internal granule (Fig. 50). First and second metasomal segments bear 10 keels, third through fourth segments bear eight keels. Ventral surface of seventh segment with four keels. For position and distribution of trichobothria on tibia of pedipalps see Fig. 69. Subaculear tooth with two conspicuous medial granules. Pectinal teeth number 8–12. Legs, metasoma, and pedipalps uniformly spotted.

COMMENTS. The species is based on a single female preserved dry in the collection of Mr. Ciming (BMNH) (Pocock 1891: 439). *L. infuscatus* is very similar to *L. perfidus*, the chief difference being the size of the subaculear tooth (see Figs 103 and 104). The two species also differ in the position of trichobothrium db on the fixed fingers of pedipalps (Figs 69 and 78) and in geographic distribution. However, the position of trichobothrium db could be variable, similarly to other species (e. g. *L. mucronatus*, *L. variatus*).

DISTRIBUTION. Philippines (Pocock 1891: 439).

***Lychas kamshetensis* Tikader & Bastawade, 1983**
(Tables 2–3)

Lychas (*Endotrichus*) *kamshetensis* Tikader & Bastawade, 1983: 102.

Lychas kamshetensis: Kovařík, 1995: 189.

TYPE LOCALITY. India, Maharashtra, Poona, Kamshet; NZSI.

DIAGNOSTIC CHARACTERS. Total length of female holotype 27.75 mm (Tikader & Bastawade 1983: 104). Sixth cutting edges on movable and fixed fingers of pedipalps without external and internal granules (Tikader & Bastawade 1983: 103, 105, figs 275 and 285). First through third metasomal segments with 10 keels, but two lateral keels on second and third segments only sparsely crenulated (Tikader & Bastawade 1983: 106). For position and distribution of trichobothria on tibia, patella, and femur of pedipalps see Tikader & Bastawade 1983: 105, figs 281–285. Pectinal teeth number 20 (Tikader & Bastawade 1983: 106). Fingers of tibia of pedipalps darker than manus of tibia (Tikader & Bastawade 1983: 103, fig. 274). For habitus see Tikader & Bastawade 1983: 103, fig. 271.

COMMENTS. The species is based on a female obtained by B. S. Lamba on 15 July 1966 (Tikader & Bastawade 1983: 107).

Unfortunately, I have not been able to examine the types or any other specimens of this species, and the diagnostic characters are therefore based solely on the authors cited.

DISTRIBUTION. India (Tikader & Bastawade 1983: 107).

***Lychas kharpadi* Bastawade, 1986**
(Tables 2–3)

Lychas (Alterotrichus) kharpadi Bastawade, 1986: 634.

Lychas kharpadi: Kovařík, 1995: 189.

TYPE LOCALITY. India, Maharashtra, Nasik district, Taluk Peinth, Harsul, Near Kharpadi village; NZSI.

DIAGNOSTIC CHARACTERS. Total length of male holotype 38.75 mm and of female allotype 45.25 mm (Bastawade 1986: 634). Sixth cutting edge on movable fingers of pedipalps with two external granules (Bastawade 1986: 635, 637, fig. 2). First and second metasomal segments with eight keels, third and fourth segments with six keels; all keels crenulated and lateral keels developed only on anterior half of third metasomal segment (Bastawade 1986: 637). For position and distribution of trichobothria on tibia, patella, and femur of pedipalps see Bastawade 1986: 636, figs 9 and 13. Pectinal teeth number 17 in male and 18 in female (types). For habitus of male see Bastawade 1986: 635, fig. 19.

COMMENTS. The species is based on two specimens (holotype male and allotype female) obtained by D. B. Bastawade on 4 February 1983 (Bastawade 1986: 637).

Bastawade's (1986: 637) observation that this species has only six keels on the third metasomal segment is very surprising. This character differentiates *L. kharpadi* from all other species of *Lychas*.

Unfortunately, I have not been able to examine the types or any other specimens of this species, and the diagnostic characters are therefore based solely on the authors cited.

DISTRIBUTION. India (Bastawade 1986: 634).

***Lychas krali* Kovařík, 1995**
(Figs 5–7, 25, 26, 66, Tables 1–3)

Lychas krali Kovařík, 1995: 190; 1997: 38.

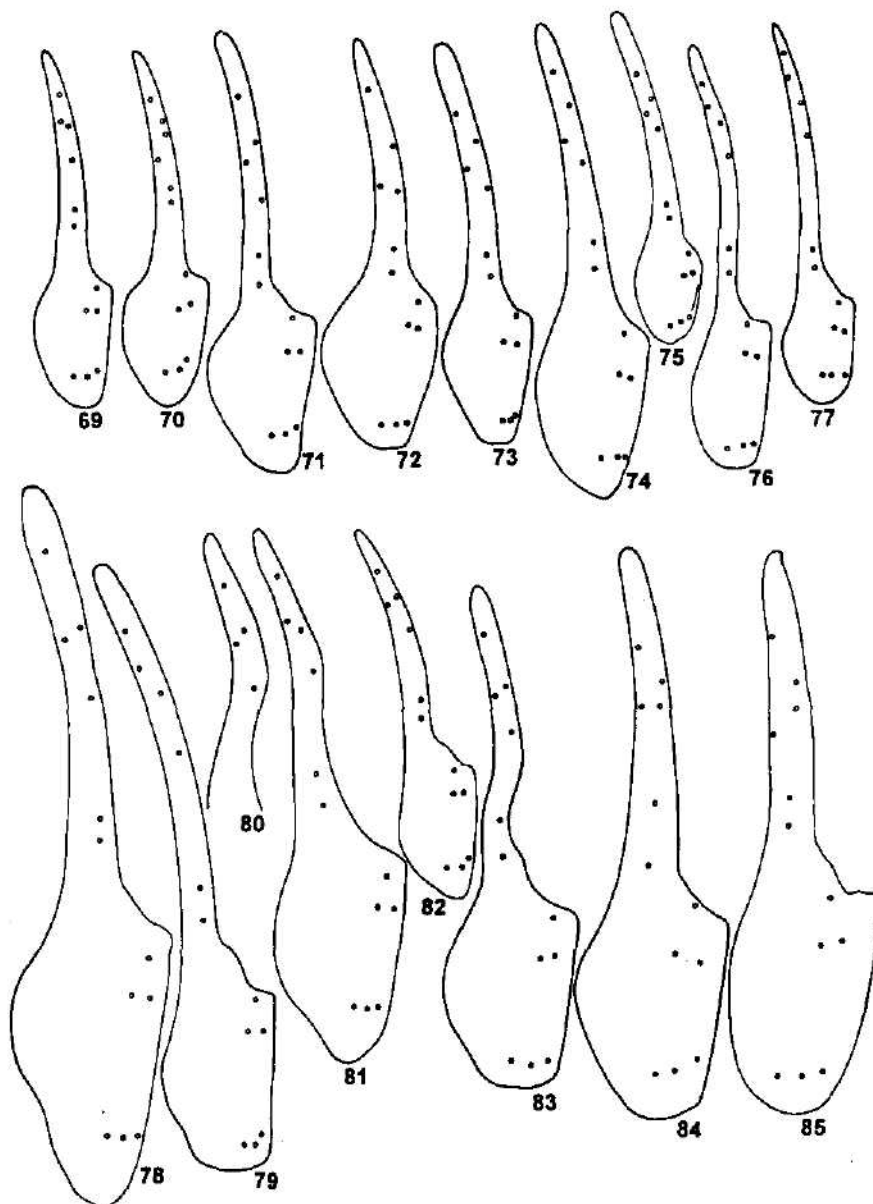
TYPE LOCALITY. Thailand, Umphang River, 16°07' N, 99°00' E; FKCP.

TYPE MATERIAL. **Thailand:** Umphang River, 16°07' N, 99°00' E, 1000 m above sea level, 28.IV.–4.V.1991, 2FE (holotype and paratype No. 6), 5FA (paratypes Nos 1–5), leg. D. Král & V. Kubáň, holotype and paratypes Nos 1–2, 5–6 FKCP, paratype No. 3 MNHN, paratype No. 4 NMPC; Lansang, 16°48' N, 98°57' E, 500 m above sea level, 18.–24.IV.1991, 1FA (paratype No. 7), 2FE (paratypes Nos 8–9), leg. D. Král & V. Kubáň, paratype No. 7, ZMUH, paratypes Nos 8–9, FKCP; Chiang Dao Mts., 19°25' N, 98°52' E, 17.–24.V.1991, 1FA (paratype No. 10), 1FE (paratype No. 11), leg. D. Král & V. Kubáň, paratype No. 10, BMNH, paratype No. 11, FKCP; 56 km NW of Chiang Mai, 19°05' N, 99°25' E, 7.–14.VI.1995, 1FA (paratype No. 12), leg. M. Snižek, FKCP.

OTHER MATERIAL. **Thailand:** NW, Phieng Dao Prov., Ban San Pakia, 1.V.1996, 2M1FA, leg. S. Bílý, FKCP; Pai Soppong, 28.V.–5.VI.1997, 1M3FA, leg. M. Snižek, FKCP.

DIAGNOSTIC CHARACTERS. Total length of males 42.2–44.5 mm, of females 30.4–39.8 mm. Male differs from female in having fingers of pedipalps proximally twisted, but not as markedly as in *L. mucronatus*, and in wider manus of pedipalps and longer metasoma. Sixth cutting edge on movable fingers of pedipalps usually with two or three external granules and one or no internal granule (Figs 5–6 and 25–26).

First and second metasomal segments bear 10 keels, third and fourth segments bear eight keels; third metasomal segment sometimes with two additional inconspicuous keels. Ventral surface of seventh mesosomal segment bears four keels, but in some specimens only two are well developed and in others all keels are barely discernible. For position and distribution of tri-



Figs 69–85 – tibia of pedipalps. Fig. 69 – *Lychas infuscatus* (Pocock), female from MNHN. Fig. 70 – *L. laevifrons* (Pocock), female from MNHN. Fig. 71 – *L. marmoreus* (C. L. Koch), male from FKCP. Fig. 72 – *L. mjobergi* Kraepelin, female LT. Fig. 73 – *L. obsti* Kraepelin, female LT. Fig. 74 – *L. rugosus* (Pocock), male HT. Fig. 75 – *L. scaber* Pocock, female HT. Fig. 76 – *L. scutillus* C. L. Koch, female from FKCP. Fig. 77 – *L. shelfordi* (Borelli), male LT. Fig. 78 – *L. perfidus* (Keyserling), female LT. Fig. 79 – *L. nigristeris*, female from FKCP. Fig. 80 – *L. mucronatus* (Fabricius), male from FKCP. Fig. 81 – *L. mucronatus* (Fabricius), male from FKCP. Fig. 82 – *L. mucronatus* (Fabricius), female HT of *L. mentawaius* Roewer. Fig. 83 – *L. rackae* sp. n., male HT. Fig. 84 – *L. shoplanti* (Oates), female LT. Fig. 85 – *L. tricarinatus* (Simon), female from SMFD.

chobothria on pedipalps see Fig. 66. Base color is yellow, with well marked black reticulation. Pectinal teeth number 15–19. For habitus see Kovařík 1995: 192, fig. 6 (drawing) and Kovařík 1997: 38 (photo).

COMMENTS. Although this is the most recently described species of *Lychas*, it apparently is not as rare as originally anticipated (see Other material).

The holotype was originally thought to be a male (Kovařík 1995: 190), but later examination of seven other specimens has shown that all 13 specimens of the type series are females.

Contrary to the original account (Kovařík 1995: 190), the paratypes Nos 3, 7, and 10 are now deposited at MNHN, ZMUH, and BMNH, respectively.

DISTRIBUTION. Thailand (Kovařík 1995: 190).

***Lychas laevifrons* (Pocock, 1897)**

(Figs 8, 27, 70, Tables 1–3)

Isometrus shoplandi: Pocock, 1891: 434 (in part).

Archisometrus laevifrons Pocock, 1897: 113.

Archisometrus shoplandi laevifrons: Kraepelin, 1899: 50.

Lychas laevifrons: Pocock, 1900: 41; Kraepelin, 1913: 133; Takashima, 1945: 83; L. E. Koch, 1977: 124; Kovařík, 1995: 189.

Lychas (*Endotrichus*) *laevifrons*: Tikader & Bastawade, 1983: 79; Tikader, 1987: 32.

TYPE LOCALITY. India, Calcutta; BMNH.

MATERIAL. **India**: Chiriga Shang, X.1912, 3FA, "Mus Calcutta", ZMUH; Calcutta ?, X.1912, 4FA, "Mus Calcutta", ZMUH; Anantigheri, Calcutta, X.1912, 1FA, Mus. Calcutta, ZMUH; Madhya Pradesh, Chota Nagpur, Pass between Chaibassa and Chakardharpur, 2.–4.III.1913, 2FA, leg. F. H. Gravely, MNHN No. RS 1690/17; Distr. Bengalen, Pun, Barkul, VII.1913, 2FA, "Mus Calcutta", ZMUH; Chota Nagpur, VII.1913, 2FA, "Mus Calcutta", ZMUH; Manghu, Ijuv.A, MNHN No. RS 1471. **Nepal**: Butwal, Tensing, I.I.1957, 1FA, leg. Hubert, MNHN No. RS 8228; Mission Oust-Nepal, Paltune, 1973, 2FA, MNHN No. RS 6619.

DIAGNOSTIC CHARACTERS. Total length 31 mm (Pocock 1897: 113) to 58.2 mm. Sixth cutting edges on movable and fixed fingers of pedipalps without external and internal granules (Figs 8 and 27). First through third metasomal segments with 10 keels, but two lateral keels on third segment weakly developed. Second through sixth mesosomal segments with three or one dorsal carinae. For position and distribution of trichobothria on tibia, patella, and femur of pedipalps see Fig. 70 and Tikader & Bastawade 1983: 83, figs 212–216. Pectinal teeth number 22–25. Fingers and manus of tibia of pedipalps of the same color, light and spotted (Tikader & Bastawade 1983: 81, fig. 205). Legs variegated black and yellow (Pocock 1897: 113). Tibial spurs markedly long. For habitus see Tikader & Bastawade 1983: 81, fig. 202.

COMMENTS. Pocock (1891: 434) at first thought that the type specimen belongs to *L. shoplandi*, and only in 1897 used that specimen to describe *L. laevifrons*.

DISTRIBUTION. India (Pocock 1897: 113), Nepal (first report).

***Lychas lourencoi* sp. n.**

(Figs 18, 37, 89, 106, Tables 1–3)

TYPE LOCALITY. Indonesia, Java; MNHN.

TYPE MATERIAL. **Indonesia**: Java, 1FA (holotype), MNHN No. RS 1489.

ETYMOLOGY. Named after the French arachnologist Wilson R. Lourenço of the Muséum national d'Histoire naturelle, Paris, France.

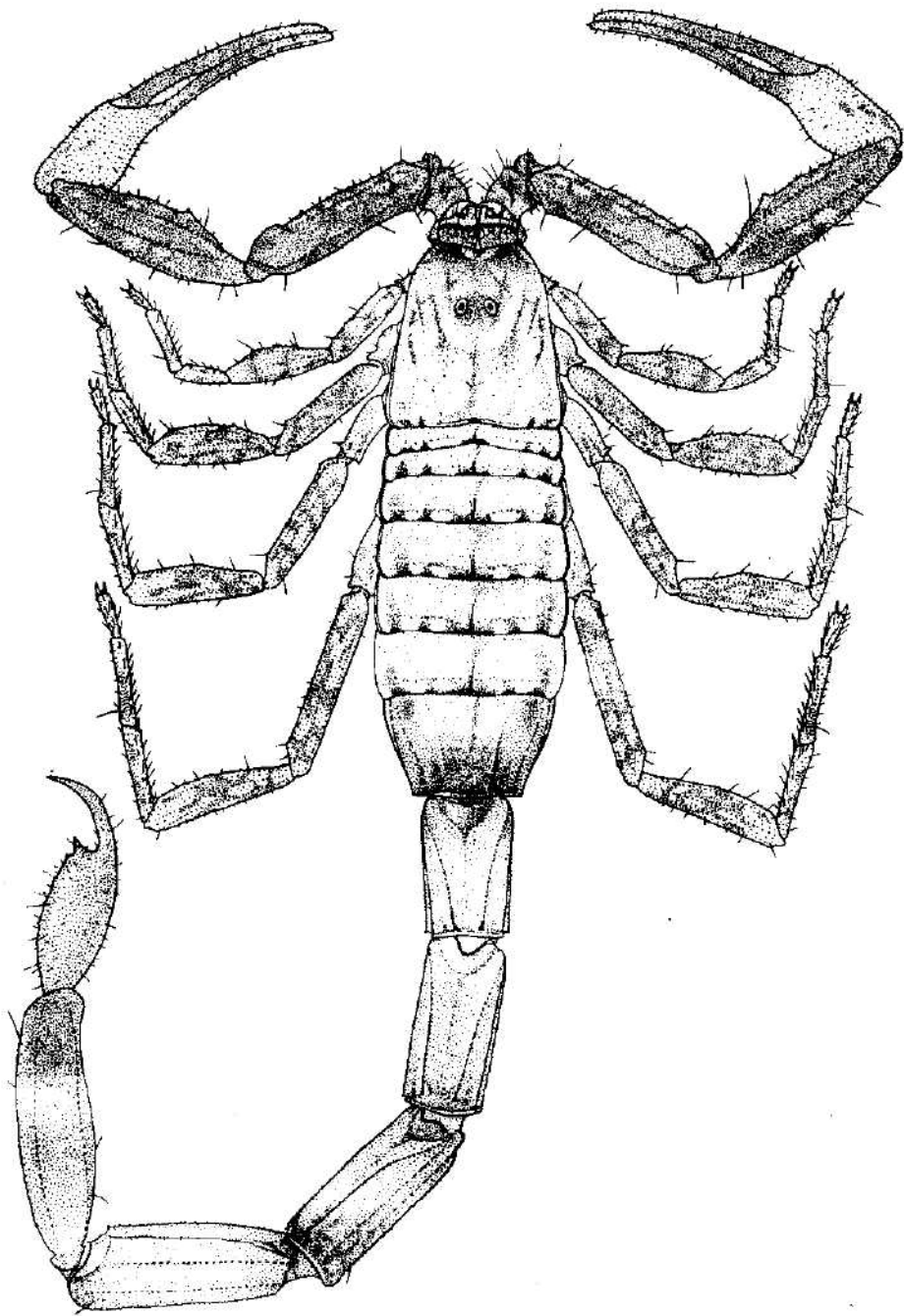


Fig. 86 – *Lychas nigristernis* (Pocock), male from FKCP. Dorsal aspect.

DESCRIPTION. The total length of the female holotype is 27.9 mm. The habitus is shown in Fig. 106. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. Pectinal teeth number 11–12 in the female holotype. For the position and distribution of trichobothria on the tibia of pedipalps see Fig. 89.

The base color is uniformly yellow, with well marked brown reticulation.

The chelicera is reticulated. The fingers of chelicera bear brown spots.

The carapace is without keels but bears large granules.

The femur, patella, manus, and fingers of pedipalps are dorsally and laterally uniformly yellow with brown spots. The ventral surface of femur and tibia of pedipalps is yellow. The sixth cutting edge on the movable fingers of pedipalps with two external granules, on the fixed fingers with one internal granule and two external granules (Figs 18 and 37).

The mesosoma has an elevated median keel and large granules. The posterior margins of the first through sixth segments each bear six nearly circular pale – yellow spots which are symmetrically distributed. The ventral surface of the seventh segment bears four keels and a number of conspicuous granules.

The legs have the same color pattern as the pedipalps.

The metasoma is spotted, more so in the posterior half. The first and second segments bear 10 keels, the third and fourth segments bear eight keels. The subaculear tooth is pronounced, pointed, with one row composed of two granules in the upper midline.

AFFINITIES. The described features distinguish *L. lourencoi* sp. n. from all other species of the genus *Lychas*. They are recounted in the key below.

L. lourencoi sp. n. is closest to *L. kralli*, from which it differs in the number of pectinal teeth.

L. lourencoi sp. n. differs from *L. feae* (Myanmar, not included in the key) in the color of the manus of pedipalps, carapace, terga, and legs, which are black in *L. feae* (Pocock 1900: 42).

***Lychas marmoreus* (C. L. Koch, 1844)**

(Figs 44, 49, 71, 109, Tables 1–3)

Tityus marmoreus C. L. Koch, 1844: fig. 868; 1845a: 36.

Tityus marmoreus: C. L. Koch, 1850: 91.

Archisometrus marmoreus: Kraepelin, 1891: 226 (in part); 1895: 85; Lönnberg, 1897: 183; Kraepelin, 1899: 49 (in part); Brignoli, 1985: 415.

? *Archisometrus* cf. *marmoreus*: Kraepelin, 1901: 268.

Lychas marmoreus: Kraepelin, 1908: 87 (in part); 1916: 26 (in part); Birula, 1917a: 105; Kopstein, 1921: 124; 1923: 186; Glauert, 1925: 95 (in part); Werner, 1936: 181; Takashima, 1945: 80; Glauert, 1963: 183; Sreenivasa-Reddy, 1968: 760; L. E. Koch, 1977: 124; 1981: 877; Locket, 1990: 79; Polis, 1990: 263; Locket, 1993: 593; Kovařík, 1995: 189.

Lychas marmoreus marmoreus: Glauert, 1925: 97; Giltay, 1931: 18; Glauert, 1963: 183; Cekalovic, 1982: 190.

Lychas marmoreus typicus: Kraepelin, 1916: 27; Takashima, 1945: 80.

Isometrus bituberculatus Pocock, 1891: 243 (TL: Baudin island) (syn. by L. E. Koch, 1977: 124).

Archisometrus bituberculatus: Kraepelin, 1895: 85; 1899: 48; Borelli, 1904: 4.

Lychas bituberculatus: Birula, 1917a: 104–5; Glauert, 1925: 109; Takashima, 1945: 80; Glauert, 1963: 183.

Lychas marmoreus obscurus Kraepelin, 1916: 27 (TL: Melbourne); Glauert, 1925: 97; Takashima, 1945: 80 (syn. by L. E. Koch, 1977: 125).

Lychas marmoreus nigrescens Kraepelin, 1916: 27 (TL: Sidney); Glauert, 1925: 97; Takashima, 1945: 80 (syn. by L. E. Koch, 1977: 125).

Lychas marmoreus splendens Kraepelin, 1916: 29 (TL: Ausbeute); Glauert, 1925: 98; 1925: 85; Takashima, 1945: 81; Glauert, 1963: 183 (syn. by L. E. Koch, 1977: 125).

Lychas jonesae Glauert, 1925: 110 (TL: Bulong near Kalgoorlie, Hampton Hill station, Western Australia); 1963: 183; L. E. Koch, 1980: 296; Locket, 1993: 593 (syn. by L. E. Koch, 1977: 125).

Lychas janesae: Takashima, 1945: 84.

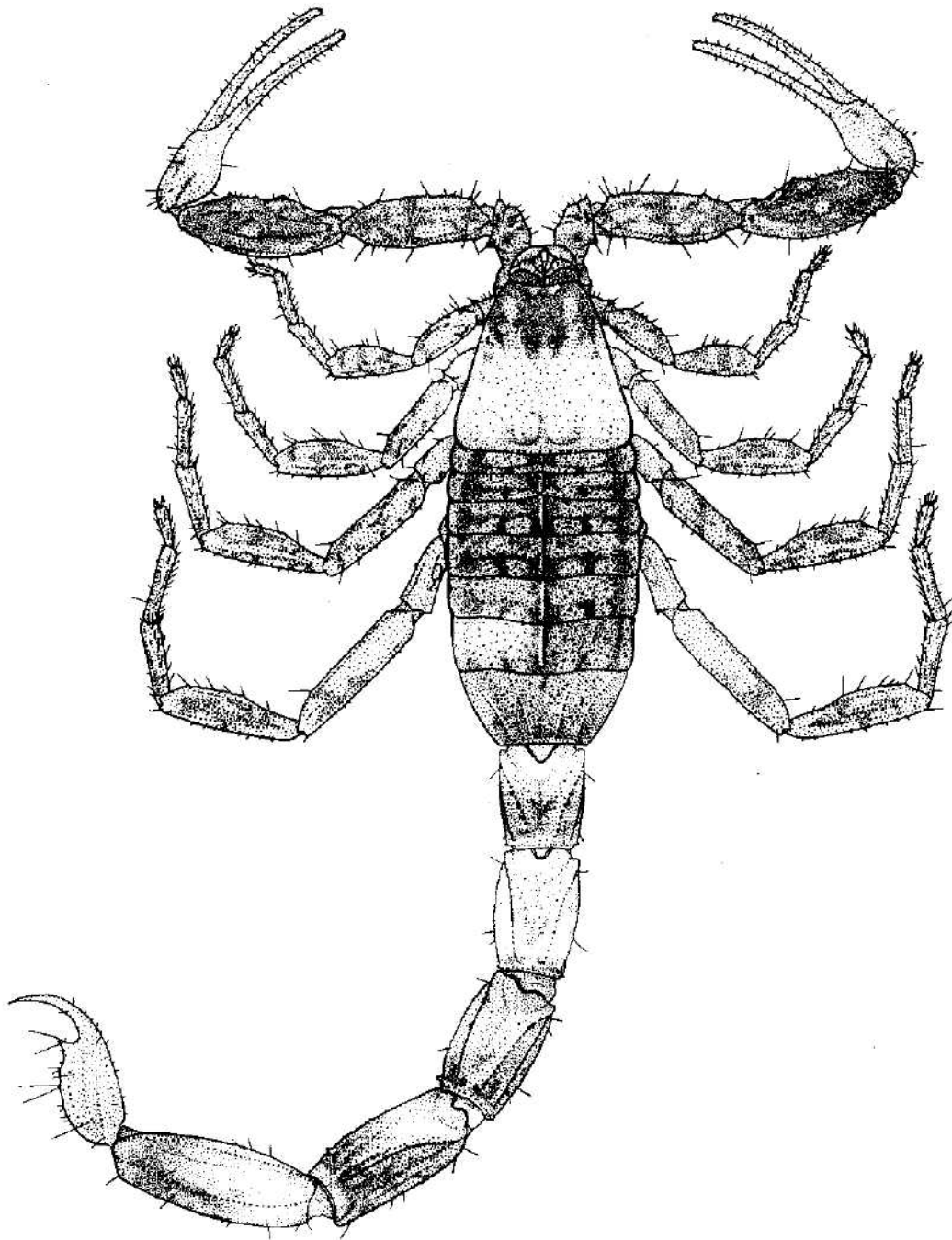


Fig. 87 – *Lychas nigristernis* (Pocock), female from FKCP. Dorsal aspect.

TYPE LOCALITY. Unknown (C. L. Koch 1845: 38); the whereabouts of the type are also unknown.

TYPE MATERIAL. **Australia:** Moora, 8.VIII.1905 (Hamburg S. W. Austral. Esp.), 1F6juvsA (lectotype and paralectotypes Nos 1–6 of *Lychas marmoreus splendens*), leg. Michaelsen, ZMUH No. 462; Melbourne, 26.III.1897, 1FA (holotype of *Lychas marmoreus nigrescens*), ZMUH; Sydney, N. S. W., 15.XII.1909, 1FA (holotype of *Lychas marmoreus obscurus*), leg. Cpt. Schmidt, ZMUH.

OTHER MATERIAL. **Australia:** IMA, det. Simon, MNHN No. RS 1482; Schradez, 2FA (defect), ZMUH; West Australia, Chapman River, 10 miles NE of Sevaldton, 1FA, leg. E. H. Saunders, BMNH, No. 1895.6.20.2, rev. L. E. Koch; 1895, 1FA, SMFD; North, Subiaco, 26.VI.1905, 1FA, Hamburg S. W. Austral. Exp. 1905, ZMHB No. 10533; Boorabin, 3.VII.1905, 1MA, ZMHB No. 10500; Northampton, 15.VII.1905, 1juv.A, Hamburg S. W. Austral. Exp. 1905, ZMHB No. 10532; Boyanup, 1.–3.VIII.1905, 3juvsA, Hamburg S. W. Austral. Exp. 1905, ZMHB No. 10535; Subiaco, 4.–5.IX.1905, 6F3juvsA, leg. Michaelsen, ZMUH; Boyanup, VI. 1908, 2M(im)2FA, leg. Michaelsen, ZMUH; VII.1909, 1FA, ZMHB No. 10532; 23.VI.1911, 1FA, leg. O. Frank, SMFD; Sydney, 4FA, leg. Helms, ZMUH No. 4/1941; Perth, VIII.1912, 1M(im)1FA, leg. Mjöberg, ZMUH; Adelaide, 1952–1953, 1MA, leg. Hendenstrom, 16.III.1957, 1FA, leg. Falten, SMFD; 1 mi S Kumari, 25.X.1954, 1FA, leg. J. H. Callaby, MNHN No. 4418; Belmont, 1955, 1FA, MNHN No. 4417; Perth, City Beach, 29.V.1958, 1FA, leg. J. A. Philipp, SMFD; Buthurst, II.1959, 1ME, leg. M. Bužga, FKCP; Toronto, 1960, 2M2FE, FKCP; Perth National Park, "Blach Boy", 9.VIII.1968, 1juv.A, leg. J. Balogh, HNHM No. Perth.C.2.; Perth, 1968–1972, 1MA (im), leg. J. Balogh, HNHM No. PER-R.1; Adelaide, 1968–1972, 1M1FA (im), leg. J. Balogh, HNHM No. ADL.R.1.; South Australia, Naimo, 13.VII.1986, 3FA, leg. J. Ferrel, MBCZ No. 661.

DIAGNOSTIC CHARACTERS. Total length ca 35 mm in males and ca 30 mm in females. Males have much longer metasoma (Table 1) and wider vesicle than females. Sixth cutting edges on movable and fixed fingers of pedipalps usually with one external granule and no internal granules (Figs 44 and 49). First through third metasomal segments with 10 keels, but second and third segments may have only eight keels. Termination of subaculear tooth rounded (Fig. 109). For position and distribution of trichobothria on pedipalps see Fig. 71. Position of trichobothrium db is variable, in some specimens (e. g. in FKCP) between trichobothria et and est (Fig. 71) and in others (e. g. female in SMFD) between dt and et.

Entire animal is spotted, but manus is much lighter than fingers of pedipalps. Fingers are dark, but with light tips in some specimens. Pectinal teeth number 14–22 in males and 12–18 in females.

COMMENTS. In accord with the ICZN (1985), the date of original publication of *Tityus marmoreus* is March 1844, which consisted of an illustration of the species (see Brignoli 1985: 415). The text was published in 1845, which is cited by a number of authors (e. g. L. E. Koch 1977: 124) as the year of original description.

Revising the species, L. E. Koch (1977: 127) examined 116 males and 278 females, of which however less than 3% were adults. He gave a total length of 33 mm with the metasoma amounting to 21 mm for an adult male, and the number of pectinal teeth as 14–22 in the males and 12–18 in the females. The FKCP specimens have 16–17 pectinal teeth in males and 12–14 in females. The SMFD specimens have 13–16 pectinal teeth in females and 18 in males. The ZMUH females have 12–15 pectinal teeth.

In addition, I have examined the following type material:

1) The type series of *Lychas marmoreus splendens*, hereby designating a lectotype and paralectotypes Nos 1–6. The lectotype is an immature male 22.5 mm long (of which 14 mm is the metasoma), with 16 teeth in each pecten. The paralectotypes are one female (No. 1) 26 mm long, four immature males (Nos 2–5) 16.2–20.3 mm long, and one immature female (No. 6) 23.5 mm long. Pectinal teeth number 15–16 in the males and 12–13 in the females. All seven specimens of the type series have 10 keels on the first through third metasomal segments.

2) The holotype of *Lychas marmoreus nigrescens*. It is a female 31 mm long, with 15 teeth in each pecten. The first through third metasomal segments bear 10 keels.

3) The holotype of *Lychas marmoreus obscurus*. It is a female 32 mm long, with 15 teeth in each pecten. The first through third metasomal segments bear 10 keels, of which two keels on the third segment are composed of larger granules placed farther apart. There is one external granule near the sixth cutting edge on the movable fingers of pedipalps.

DISTRIBUTION. Australia (Pocock 1891: 243), New Guinea (Kraepelin 1899: 49). For distribution of *L. marmoreus* in Australia see L. E. Koch 1977: 311, map 2.

***Lychas mjobergi* Kraepelin, 1916**
(Figs 11, 30, 72, 99, 105, Tables 1–3)

Lychas mjobergi Kraepelin, 1916: 24; Takashima, 1945: 84.

Lychas mjobergi: Glauert, 1925: 108; 1963: 183.

Lychas alexandrinus (in part): L. E. Koch, 1977: 139; 1981: 877; Vachon, 1986: 845; Locket, 1990: 79; Locket, 1993: 593; Kovařík, 1995: 189.

TYPE LOCALITY. Australia, Kimberley District; ZMUH.

TYPE MATERIAL. Australia: NW, Kimberley District, 11.I.1911, IFA (lectotype), leg. Mjöberg, ZMUH.

DIAGNOSTIC CHARACTERS. Total length of female lectotype 32.4 mm. Sixth cutting edges on movable and fixed fingers of pedipalps each with one external granule and no internal granules (Figs 11 and 30). First through third metasomal segments with 10 keels, fourth segment with eight keels. For position and distribution of trichobothria on tibia and femur of pedipalps see Figs 72 and 99. Pectinal teeth number 21–22. Primary characters are very small subaculear tubercle (Fig. 105) and short, robust tibia of pedipalps.

COMMENTS. Kraepelin's (1916) description is based on two females, of which I was able to examine one herein designated the lectotype; it has 21 pectinal teeth. Kraepelin (1916: 25) counted 22 pectinal teeth, which may be the number in the other female deposited in the Naturhistoriska Riksmuseet, Stockholm (Glauert 1925: 109).

It is not clear whether other specimens of this species exist. This is because L. E. Koch incorrectly synonymized *L. mjobergi* with *L. alexandrinus* (= *Hemilychas alexandrinus*, see below), and it would thus be advisable to examine all the specimens that L. E. Koch regarded as *L. alexandrinus*.

DISTRIBUTION. Australia (Kraepelin 1916: 25).

***Lychas mucronatus* (Fabricius, 1798)**
(Figs 10, 12, 29, 31, 80–82, 93, 98, Tables 1–3)

Scorpio mucronatus Fabricius, 1793: 152 (nomen nudum); 1798: 294; Herbst, 1800: 85; Latreille, 1804: 129; Kraepelin, 1891: 228; Zimsen, 1964: 638.

Tityus mucronatus: C. L. Koch, 1843: fig. 858; 1845a: 14.

Tithyus mucronatus: C. L. Koch, 1850: 91.

Isometrus mucronatus: Simon, 1884: 45; Thorell, 1888: 337; 1889: 566; Pocock, 1893: 296.

Archisometrus mucronatus: Thorell, 1893: 368; Pocock, 1894: 359; Thorell, 1894: 14; Pavesi, 1898: 1; Kraepelin, 1899: 46; 1901: 268; Wu, 1936: 117; Bücherl, 1959: 257.

Lychas mucronatus: Pocock, 1900: 36; Kraepelin, 1905: 352; 1908: 186, 193; Henderson, 1913: 128; Kraepelin, 1913: 132; Birula, 1917a: 105; 1917b: 179; Lampe, 1918: 194; Kopstein, 1921: 123; 1923: 184; 1926: 111; Giltay, 1931: 18; Werner, 1932: 575; Fage, 1933: 25; Werner, 1934: 271; Giltay, 1935: 1; Kopstein, 1935: 210; Roewer, 1943: 213; Takashima, 1945: 79; Caporale, 1947: 247; Dammernan, 1948: 494; Glauert, 1954: 5; Sachet, 1958: 6; Minnocci, 1974: 30; L. E. Koch, 1977: 124; Vachon, 1986: 843; Vachon & Abe, 1988: 26; Kovařík, 1995: 194.

Lychas mucronatus [sic]: Fage, 1936: 181.

Lachas mucronatus [sic]: Fage, 1944: 71.

Lychas (Alterotrichus) mucronatus: Tikader & Bastawade, 1983: 53; Bastawade, 1986: 636.
Scorpio armillatus Gervais, 1841: 284 (TL: Manille); Gervais, 1844: 48; Kraepelin, 1895: 85 (syn. by Kraepelin, 1899: 46).
Scorpio (Androctonus) armillatus: Gervais, 1843: 129; ? Gervais, 1844: 215.
Isometrus armillatus: Simon, 1877: 94; Simon, 1884: 46; Thorell, 1888: 337.
Scorpio (Androctonus) curvidigitatus Gervais, 1843: 129 (TL: unknown); 1844: 214 (syn. by Thorell, 1893: 368).
Scorpio curvidigitatus: Gervais, 1844: 48.
Androctonus curvidigitus: Karsch, 1879b: 119.
Archisometrus curvidigitus: Kraepelin, 1891: 223; 1895: 84; Lönnberg, 1897: 183.
Tityus varius C. L. Koch, 1844: fig. 864; 1845a: 29 (TL: Java); 1850: 90 (syn. by Thorell, 1889: 566).
Isometrus varius: Simon, 1884: 38; 1887: 112; Oates, 1888: 248.
Isometrus chinensis Karsch, 1879a: 116 (TL: China); Aussere, 1880: 467; Simon, 1884: 46; Moritz & Fischer, 1980: 312 (syn. by Kraepelin, 1891: 223).
Lychas chhiensis: Kishida, 1933 (Takashima, 1945: 79).
Isometrus atomarius Simon, 1884: 39 (TL: Birmanie); Oates, 1888: 247 (syn. by Kraepelin, 1891: 223).
Lychas atomarius: Vachon, 1986: 839.
Lychas mentawaius Roewer, 1943: 212 (TL: Sipora, Mentawai-Inseln); Vachon, 1986: 841; Kovařík, 1995: 189. **Syn. n.**
Lychas baldasseroni Caporacci, 1947: 248 (TL: Birmania, Bhamo); Bartolozzi, Vanni & Mascherini, 1987: 294. **Syn. n.**
? Lychas nucifer Basu, 1964: 100 (TL: India, Behar, Hazaribagh); Minnocci, 1974: 30; Kovařík, 1995: 189. **Syn. n.**
Lychas sp.: Kovařík, 1992: 183.

TYPE LOCALITY. India orientali; UZMD.

TYPE MATERIAL. **China:** 2FA (syntypes of *Isometrus chinensis*), leg. Nissen, ZMHB No. 3041, labeled: *Archisometrus curvidigitus* (Gerv.). **Indonesia:** Montawein-Inseln, Sipora, 1FA (holotype of *Lychas mentawaius*), SMFD No. 8870/212, rev. M. Vachon 1981 No. VA 2467. **Myanmar:** Bhamo, 1M3FA (lectotype and paralectotypes Nos 1–3 of *L. baldasseroni*), MZUF.

OTHER MATERIAL. **Cambodia:** Siem Reap, 1MA, MNHN No. RS 1524; Kampong, 1935, 1FA, leg. Dawydoff, MNHN No. RS 1527; Angkor, 1935, 1FA, leg. Dawydoff, MNHN No. RS 1535. **China:** Hongkong, Realgymnas, 1890, 2FA, leg. Weiler, ZMUH; Insel Hainan, IV.1909, 3FA, leg. Schoede, ZMHB No. 11348; Hongkong, V.–VI.1911, 6FA, leg. R. Mell, ZMHB No. 554/1918; Ladung, 9.VIII.1995, 1FA, ZMUH. **India:** 1M7F1juv.A, MNHN No. RS. 1495; Dawna Hills, 23.–24.XI.1911, 1M1FA, leg. F. H. Gravely, MNHN No. RS 1275/17; Nord Kanara Karwa, 1955–57, 1FA, Deutsche Indien Expedition, ZMUH No. 324. **Indonesia:** Java, 2juvsA (after third ecdysis), ZMHB No. 8145, 3M1FA, ZMHB No. 7334, 2FA, ZMHB No. 7463; Archipel, 1890, 1FA, ZMUH; Batavia, 1890, 1M1FA, ZMUH; Timor, 1893, 1M1FA, ZMUH; Java, Batavia, 27.IX.1897, 3M2FA, leg. Wülfing, ZMUH; Java, 27.VII.1909, 1FA, leg. Schwinghauer, ZMUH; Bocton, 1909, 1FA, Sunda Exped. des Frankf., leg. J. Elbert, SMFD; Isambawa, Ampang, 2.I.1910, 1MA, Sunda Exped. des Frankf., leg. J. Elbert, rev. M. Vachon 1981 No. VA 2659, SMFD; Java, Buitenzorg, Botanischer Garden, 1925, 1juv.A, leg. H. Winkler, ZMUH; Badjawa, Central-Flores, 1MA, 17.VI.1927, ZMHB No. 10499; Mavia, Sunda Exp., 2.–4.VI.1927, 1FA, leg. Renfch, ZMHB No. 11345; West Taures, Rang Mesc, Sunda Exp., 20.–21.VI.1927, 1FA, leg. Renfch, ZMHB No. 11344; Lombok, Ekas, 1FA, ZMHB No. 11430; Swela, Lombok, Sunda Exp., 22.–29.III.1927, 5F1juv.A, leg. Renfch, ZMHB No. 11429; Semankat, Sunda Exp., 10.V.1927, 1M1FA, leg. Renfch, ZMHB No. 11342; Fernes, Sunda Exp., 10.–15.V.1927, 1FA, leg. Renfch, ZMHB No. 11343; Flores, 1FA, leg. Martens, ZMHB No. 7589; Batae Doelang, Suumbava, Sunda Exp., 10.–15.V.1927, 14M8FA, leg. Renfch, ZMHB No. 11346; Angloi (Bava), 350–500 m, 28.IX.1931, 2MA, MNHN No. RS 1509; Komodo, Petits ile de la Sante, 1956, 1FA, leg. Pfeiffer, MNHN No. RS 8591; Timor, Lamaknen, 1000 m, 1970, 1MA, leg. B. Friedberg, MNHN No. RS 6449; Java or Sumatra, 1F1juv.A (juv. after third ecdysis), MNHN No. RS 1497; Java, 2FA, MNHN Nos RS 1489 and 3598; Java, Batavia, 1M1FA, MNHN Nos RS 1505 and 3472; Timor, Damaknen, alt. 1000 m, 1FA (im), leg. Friedberg, MNHN No. RS 6448. **? Indonesia:** ? Java, 24M33FA, ZMHB No. 7399. **Laos:** Prov. Common, Village de Na Kay Khia, 1933, 1FA, MNHN No. RS. 4540; Luang Prabang, 1M5F3juv.A, IX.1933, leg. Dawydoff, MNHN RS 1519 and 1529; Taket, 1933, 1F3juvsA (2juvs before first ecdysis), leg. Dawydoff, MNHN No. RS 1532; Vicinitine, X.1933, 1FA, leg. Dawydoff, MNHN No. RS 1525; Sawannakot, 4M2FA, leg. Dawydoff, MNHN; Haut Laos, X.1934, 2FA, MNHN RS 1531; Vientiane, I.1935, 1M9juvsA (juvs before first ecdysis), leg. Dawydoff, MNHN RS 1536; Haut Laos, Phang-Sali, 1938–9, 1M1FA, leg. Dawydoff, MNHN RS 1522; Haut Laos, Paclay, Sayaburi, I.1939, 2juvsA, leg. Dawydoff, MNHN RS 1539; Dong Doh, 20.III.1990, 1 juv.A (after third ecdysis), leg. Kondorosy, HNHN; Boli Kham Xai prov., 18°16'N 103°11'E, 70 km NE of Vientiane, 27.–30.IV.1997, 1M3F7juvsA (juvs before first ecdysis), leg. V. Kubán, FKCP. **Malaysia:** Singapore, 1juv.A (after third ecdysis), ZMHB No. 7236; Bali Island, 1ME, collector unknown, det. 1990, NMPC; Bali Island, II.1996, 2MA, leg. L. Hadaš, FKCP. **Myanmar:** Ober Birma, Thomaran Gillis, 1juv.A (after fourth ecdysis), ZMHB No. 8144; Viaggio in Birmania, Palon (Pego), 1885–89, 1M7FA, leg. L. Fca, ZMUH. **Philippines:** Manila, 1980, 1FA, ZMUH. **Thailand:** Bangkok, 1FA, leg. Martens, ZMHB No. 8142; Siam, 1MA, leg. Martens, ZMHB

No. 8142, IFA, ZMHB No. 11349; Siam, 1879–95, 4M5FA, det Kraepelin 1900 as *Archisometrus mucronatus*, MNHN No. RS. 1452; Siam Micro, IFA, MNHN No. RS 1488; Peninsula de Moluccen, IFA, leg. Balayus, MNHN No. RS 7025; Bangkok, 7.XI.1891, IFA, ZMUH; Siam, MUok-Iek, 25.V.1904, 1M3FA, leg. Fruhstortler, ZMUH; Isthme of Kra, 22.VI.1986, IMA, leg. P. Leclere, ZMUH; Chiang Mai, 15.VII.1987, 2FE, leg. C. M. Brandstetter, FKCP; Lat Yao, 25 km W Nakhon-Sawan, ca 80 m, VII.1987, IFA, leg. Thielen, SMFD; Kanchanaburi, near river Kwai, 5.IV.1991, 1M1F 1juv.E 3FA, leg. J. Farkač, FKCP; Lansang, 500m above sea level, 18–24.IV.1991, 2FE, leg. D. Král & V. Kubán, FKCP; Palong near Fang, 750m above sea level, 19°55'N, 99°06'E, 27.V.1991, 1M1FE IFA, leg. D. Král & V. Kubán, FKCP; Samut, 12.II.1993, IMA, collector unknown, FKCP; Sai Buri, 23–27.IV.1993, 2FE 1F2juvsA, leg. J. Strnad, FKCP; Mae Hong Son env., Ban Huai Po, 1700m above sea level, 24–30.VI.1993, 1ME, leg. J. Schneider, FKCP; Mae Hong Son, Nupa-Ah, 30.VI.1993, 4FE 5FA, leg. J. Schneider, FKCP; Kaeng Krachan (Phetchaburi), Kaeng Krachan National Park, Reservoir, 6.II.1994, IMA, leg. S. & L. Mahunka, HNHN; 56 km NW Chiang Mai, 19°05'N, 99°25'E, 7–14.II.1995, 6F22juvsA (juvs before first ecdysis), leg. M. Snižek, FKCP; Chiang Dao env., 21.V–4.VI.1995, 1M2FA, leg. M. Snižek, FKCP; Erewan, III.1997, IMA, leg. V. Sejna, FKCP; Chiang Dao, 19–21.V.1997, 2FA, leg. M. Snižek, FKCP. **Vietnam:** Saigon, 2M3F1juv.A, MNHN Nos RS 1493, 1502, and 1506; Indochine, Monci-Sai, IMA, leg. Dawydoff, MNHN No. RS 1521; Indochine, Hvé. Annam, 2FA, leg. Dawydoff, MNHN No. RS 1526; Snol Dam, IX.1912, 1M1FA, MNHN No. RS. 1504; Dong-Trang (Song-Cay), XI.1929, IFA, MNHN No. RS 1510; Indochina, Tourane, Annam, Lien-Cheu, 18.IX.1931, IMA, MNHN No. RS 1514; S. Annam, Nhatrang, Cauda, I.1930, IMA, VI.1931, IFA, XII.1931, 1juv.A, MNHN No. RS 1513, 1516, and 1517; Indochina, Tourane, Annam, 2FA, leg. Dawydoff, MNHN No. RS 1523; S. Annam, Cauda (Nhatrang), III.1933, 3FA, leg. Dawydoff, MNHN No. RS 1530; Annam, Kontoum, 1933, 2FA, leg. Dawydoff, MNHN No. RS 1533; Indochina, Cauda, 1933, IMA, leg. Dawydoff, MNHN No. RS 1518; Indochina, Konan Tchan, 1937, 3M7FA, leg. Dawydoff, MNHN No. RS. 1470; Indochina, S. Annam, Nhatrang, 1938–9, 1M1FA, leg. Dawydoff, MNHN No. RS 1520; Annam, Quinhon, X.1934, IMA, MNHN No. RS 1537; Haut-Tonkin, Lao-Kay, XII.1933, IFA, leg. Dawydoff, MNHN No. RS 1534; Saigon, I.1935, IMA, leg. Dawydoff, MNHN No. RS 1538; Saigon, 1989, 1M1FE, leg. Jansa, FKCP; near Binh-Chan, 23.IV.1989, 1FE, leg. S. Bečvář, FKCP; Hanoi, X.–XI.1991, 3M3FE 9M18F2juvsA, leg. R. Hanzal, FKCP; 80 km NNE Saigon, Dong Nai prov., valley Ma Da, Tri An dam, VII.1995, 2FA, 7.VI.1996, 1juv.A (after third ecdysis), leg. K. Petrželka, FKCP; Saigon, 4.X.1995, 1juv.A (after fourth ecdysis), leg. K. Petrželka, FKCP. ? **Vietnam:** Darlac, Ben-Methuot, 600 m, VI.1930, 3F7juvsA (juvs before and one after first ecdysis), MNHN No. RS 1508; Darlac, Plateau de Medrac, 30.VI.1930, IFA, MNHN No. RS 1515; Darlac, Ben-Methuot, 1931, 3FA, I.1931, 2FA, MNHN No. RS 1507 and 1511; Indochine, X.1934, IMA, leg. Dawydoff, MNHN No. RS 1528. ? Bric Along, X.1934, 4FA, MNHN No. RS 1474; Cochinchina, IFA, MNHN No. RS 1503; 1M1FA, MNHN No. RS 1457; Amboina, 1893, 1M2FA, ZMUH; Soemba, 1893, 1M1FA, ZMUH; Tavoy, X.1912, 2M3FA, Mus. Calcutta, ZMUH; Hainan Garzoni, 2F1juv.A (juv. after first ecdysis), MNHN; IFA, MNHN No. RS 1453; 2M9FA, ZMHB No. 3067; 1M3FA, ZMHB No. 2597; Savataca, 1M5FA, leg. Martens, ZMHB No. 7644; IFA, ZMHB No. 2598; IMA, ZMHB No. 8143; Franz Wintesinber, Sragan, IFA, ZMHB No. 11347; Kangean, 2FA, ZMUH.

Specimens born and reared in captivity (females from **Vietnam:** Hanoi, X.–XI.1991, leg. R. Hanzal): 3juvsE after the first ecdysis, 3juvsE 12juvsA after the second ecdysis, 3juvsE 6juvsA after third ecdysis, 3juvsE 19juvsA after the fourth ecdysis, 6FE 4M8FA after the fifth ecdysis (birth 30.III. and 4.IV.1992, first ecdysis 4. and 8.IV.1992, second ecdysis 5.–18.V.1992, third ecdysis 28.V.–16.VI.1992, fourth ecdysis 23.VI.–23.VII.1992, fifth ecdysis 22.VII.–15.IX.1992, one female scorpion-born 16.VI.1993, breeding F. Kovarik), FKCP.

DIAGNOSTIC CHARACTERS. Total length 40–65 mm in both males and females. Male differs from female in having fingers of pedipalps proximally twisted (Figs 80–81) so that their edges cannot meet. Sixth cutting edges on movable and fixed fingers of pedipalps usually with three external granules each (Figs 10, 12, 29, and 31), very rarely with two or four granules. First and second metasomal segments with 10 keels, third and fourth segments with eight keels. Four lateral keels may be inconspicuous and sometimes smooth. Ventral surface of seventh mesosomal segment with two keels that are not always discernible. For position and distribution of trichobothria on pedipalps see Figs 80–82, 93, and 98. Position of trichobothrium db is variable (Kovářik 1995: 188).

Color pattern blotched, manus of pedipalps light, fingers dark, pronounced dark triangle in anterior part of carapace. For habitus see Vachon 1986: 843, fig. 9. Pectinal teeth number 16–26.

COMMENTS. Tikader & Bastawade (1983: 60) stated that they had examined type specimens deposited in BMNH, No. 1889.3.29.9–11, which is a case of mistaken identity. As types must be

unequivocally regarded specimens in the Fabricius collection, which is at UZMD (see Zimsen 1964).

L. mucronatus was characterized by Roewer as having 10 keels on the second metasomal segment, two keels on the underside of the seventh mesosomal segment, total length of 50–58 mm, and 21 pectinal teeth. Pocock gave a total length of 58 mm for the female and 53 mm for the male, and also about 21 pectinal teeth.

My examination of a number of specimens revealed the keels on the underside of the seventh mesosomal segment to be often indistinct, indicated only by several widely spaced granules. The largest specimens in my collection come from Thailand (Chiang Dao) and are about 55 mm (female) and 62 mm (male) long. Females from Nupa Ah are about 57 mm long. Other specimens from Thailand range from 45 to 50 mm in length, only one female from Lansang is 40 mm long. Specimens from Vietnam (Hanoi) are 43–55 mm (female) and 43–53 mm (male) long. Females from Vietnam (MNHN) are up to 63 mm long.

I examined the syntypes of *Isometrus chinensis*. For dimensions of one of the females see Table 1. The second differs only in having 21 pectinal teeth.

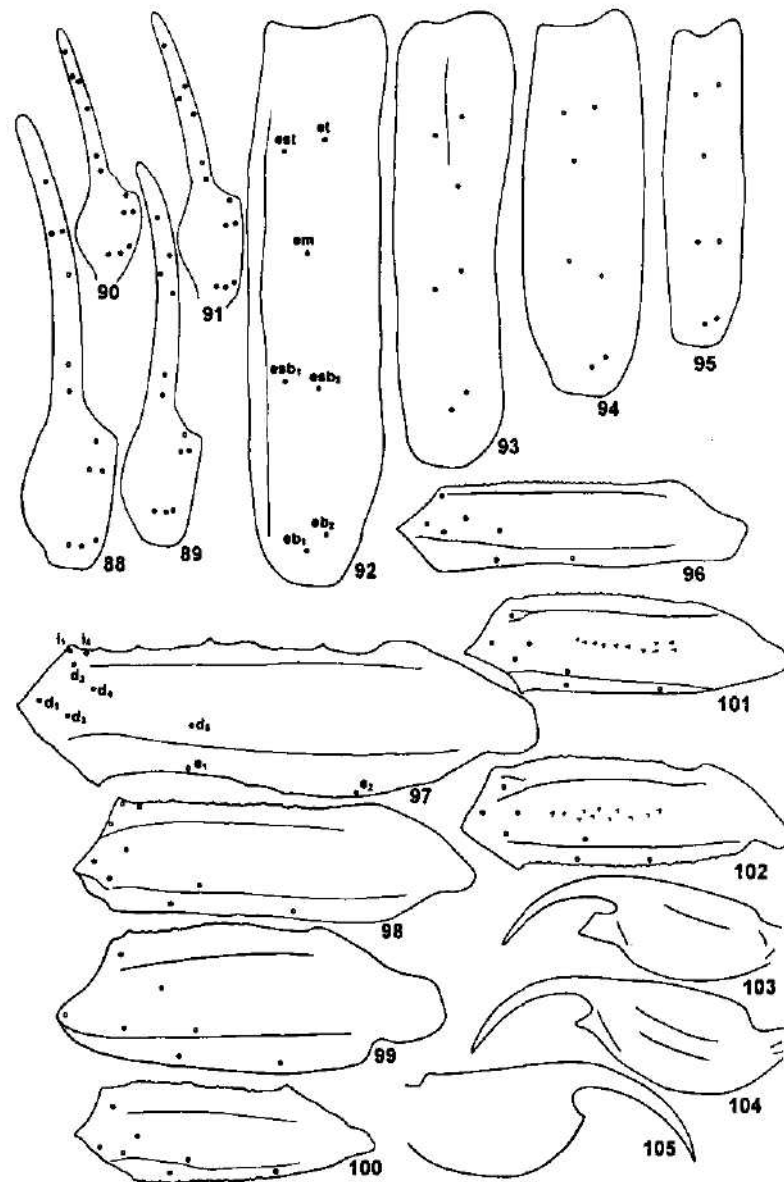
I examined the holotype of *L. mentawaius*, a female 57 mm long. The sixth cutting edge on the movable fingers of pedipalps has three external granules, and on the fixed fingers three external granules and one internal granule (Figs 10 and 29). The first and second metasomal segments bear 10 keels, and the third and fourth segments bear eight keels. The ventral surface of the seventh segment bears two conspicuous keels and two short, inconspicuous keels. For position and distribution of trichobothria on the tibia, patella, and femur of pedipalps see Figs 82, 93, and 98. Roewer (1943: 212) counted 23 pectinal teeth, but my examination shows 20 teeth in each pecten. I am certain that *L. mentawaius* is a synonym of *L. mucronatus*. Roewer mistakenly thought that *L. mentawaius* has nine cutting edge on the movable fingers of pedipalps (Roewer 1943: 213, Tafel 1, fig. 2c; Vachon 1986: 840–841).

I examined the type series of *Lychas baldasseronii*, hereby designating a lectotype and paralectotypes Nos 1–3, and am certain that it is a synonym of *L. mucronatus*. The lectotype is a male 55 mm long (of which 31 mm is the metasoma), with 20 and 21 pectinal teeth. The paralectotypes are three females 46.9–50.5 mm long, with 20–21 pectinal teeth.

L. nucifer is based on one female from Hazaribagh, Behar prov., India (Basu 1964: 101). Other authors do not mention additional specimens, and Tikader & Bastawade (1983) do not list this species for India. Bastawade (in litt., 3 April 1996) informed me that types do not exist, as "Unfortunately Dr. Basu has not preserved the types". I believe *L. nucifer* to be a synonym of *L. mucronatus*, with which it agrees in all the characters given by Basu (1964), and even in characters which he used to differentiate between the two species ("22 teeth in pecten, second metasomal segment longer than wide"). The description by Basu (1964) does not include any characters that would allow to differentiate *L. nucifer* from *L. mucronatus*.

DISTRIBUTION. Cambodia (Pocock 1894: 87), China (Karsch 1879a: 116), India (Fabricius 1798: 294), Indonesia (C. L. Koch 1845a: 16; Pocock 1894: 87; Lampe 1918: 194), Laos (Fage 1933: 26), Malaysia (Pocock 1900: 37), Myanmar (Simon 1884: 38), Philippines (Gervais 1841: 284), Thailand (Kopstein 1921: 123), and Vietnam (? Gervais 1841: 284, ? Pocock 1894: 87; Fage 1936: 181; Kovarik 1995: 194).

This species has been mistakenly recorded from Madagascar (Gervais 1844: 215), Japan, and New Zealand (Pocock 1894: 87).



Figs 88–105. Figs 88–91 – tibia of pedipalps. Figs 92–95 – patella of pedipalps. Figs 96–102 – femur of pedipalps. Figs 103–105 – telson. Fig. 88 – *Lychas nigristeris* (Pocock), female from FKCP. Fig. 89 – *L. lourencoi* sp. n., female HT. Fig. 90, 101 – *L. variatus* (Thorell), female LT of *L. spinatus* Kraepelin. Figs 91, 102 – *L. variatus* (Thorell), juv. LT of *L. marmoreus kimberleyanus* Kraepelin. Fig. 92 – *L. hosei* (Pocock), female HT. Figs 93, 98 – *L. mucronatus* (Fabricius), female HT of *L. mentawensis* Roewer. Fig. 94 – *L. shoplandi* (Oates), female LT. Figs 95, 97 – *L. braueri* (Kraepelin), female LT. Fig. 97 – *L. scaber* Pocock, female from BMNH. Figs 99, 105 – *L. mjobergi* Kraepelin, female LT. Fig. 100 – *L. tricarinatus* (Simon), female from SMFD. Fig. 103 – *L. infuscatus* (Pocock), female from ZMUH. Fig. 104 – *L. perfidus* (Keyserling), female LT.

***Lychas nigristeris* (Pocock, 1899)**
(Figs 9, 13, 28, 32, 79, 86–88, Tables 1–3)

Archisometrus nigristeris Pocock, 1899: 265.

Lychas nigristeris: Pocock, 1900: 38; Kraepelin, 1913: 133; Takashima, 1945: 84; Mani, 1959: 11; Minnocci, 1974: 30; L. E. Koch, 1977: 124; Kovarik, 1995: 189.

Lychas (*Distotrichus*) *nigristeris*: Tikader & Bastawade, 1983: 42.

? *Lychas decorata* Basu, 1964: 102 (TL: India, Behar, Hazaribagh); Minnocci, 1974: 30; Kovarik, 1995: 189. **Syn. n.**

TYPE LOCALITY. India, western Himalayas, Dehra Dun; BMNH.

TYPE MATERIAL. India: Dehra Dun, IFA (holotype), leg. F. Gleadow, BMNH No. BM 1897.9.17.84.

OTHER MATERIAL. India: W. Himalaya, Dehra Dun, VII.1913, IFA, ZMUH; bor., Uttar Pradesh bor., Thalari (Talwari), 10 km N of Debal, VII.1994, 2FE, leg. M. Snižek, FKCP; Uttar Pradesh bor., Karnaprayag env., 19–21.VII.1994, 1ME, leg. M. Snižek, FKCP. Nepal: 1M7F2juvsA, MNHN No. RS 6620, 8232–4, 8238–9 and 8242–3; Sitebeni, 500–600 m, 26.VII.1956, IFA, leg. M. Hubert, MNHN No. RS 8227; Gurundi, 6.I.1967, 2FA, leg. M. Hubert, MNHN No. RS 8230 and RS 8240; Narayangarh, 150–250 m, 25.VII.1967, IFA, leg. M. Hubert, MNHN No. RS 8241; Avant Dana, 300–1500 m, 26.VII.1967, 1juv.A, leg. M. Hubert, MNHN No. RS 8237; Gorkha District, Samri Bazar, 1350–1650 m, 20.VI.1993, 1M1F2juvsE, leg. J. Probst, FKCP. ?, 2FA, MNHN.

DIAGNOSTIC CHARACTERS. Total length 32–50 mm. Male differs from female in longer and narrower metasomal segments (Figs 86 and 87), and occasionally in having fingers of pedipalps proximally twisted, but not as markedly as in *L. mucronatus*. Sixth cutting edges on movable and fixed fingers of pedipalps each with one external granule and no internal granules (Figs 13 and 32). First metasomal segment with 10 keels, second through fourth segments with eight keels. Second metasomal segment bears two additional lateral keels marked by several granules. For position and distribution of trichobothria on tibia, patella, and femur of pedipalps see Fig. 88 and Tikader & Bastawade 1983: 45, figs 110–114. Position of trichobothrium db is variable (Figs 79 and 88). Pectinal teeth number 14–18. Femur of pedipalps spotted, patella entirely black, manus of tibia yellow, and fingers of tibia yellowish brown or dark brown. For habitus see Figs 86 and 87.

COMMENTS. The species is based on a single female, which I have examined. Its original color has been lost due to the long preservation in alcohol, and it is now entirely black.

Most of the specimens examined have trichobothrium db between trichobothria dt and et. One female from Nepal (MNHN) and one female from India (FKCP) have this trichobothrium between trichobothria et and est.

Two males from FKCP have fingers of pedipalps slightly twisted, whereas no twisting is present in a male from MNHN. However, all males have metasomal segments longer and narrower than females.

L. decoratus is based on two males from Hazaribagh, Behar prov., India (Basu 1964: 103). Other authors do not mention additional specimens, and Tikader & Bastawade (1983) do not list this species for India. Bastawade (in litt., 3 April 1996) informed me that types do not exist, as "Unfortunately Dr. Basu has not preserved the types". I believe *L. decoratus* to be a synonym of *L. nigristeris* because of its identical coloration, total length, number of pectinal teeth, and geographic distribution. The description by Basu (1964) does not include any characters that would allow to differentiate *L. decoratus* from *L. nigristeris*.

DISTRIBUTION. India (Pocock 1899: 266).

***Lychas obsti* Kraepelin, 1913**
(Figs 14, 33, 55, 73, Tables 1–3)

Lychas obsti Kraepelin, 1913: 175; Birula, 1915: 23; 1915: 120; 1916: 56; Borelli, 1919: 366; Roewer, 1943: 210; Caporiacco, 1949: 314; Probst, 1973: 322; Lamoral & Reynders, 1975: 511; Moritz & Fischer, 1980: 320; El-Hennawy, 1992: 127; Kovařík, 1995: 189.

Archisometrus obsti: Caporiacco, 1937: 360; Moriggi, 1941: 91.

TYPE LOCALITY. Deutsch-Ostafrika Kilimatinde; ZMUH.

TYPE MATERIAL. **Kenya**: O. Africa, 1FA (paralectotype No. 1), leg. Kolb, ZMHB No. 8148. **Somalia**: Lande der Rahanwin, X.1912, 1MA (paralectotype No. 2) 1F(im)A (paralectotype No. 3). **Tanzania**: D. O. Africa, Kilimatinde, 3.II.1912, 1FA (lectotype), leg. Dr. Obst, ZMUH.

OTHER MATERIAL. **Kenya**: Sagala Hills, XII.1993, 1FE, leg. Werner, FKCP; Voi, 8.–18.XI.1996, 1F1juv.A, 22.XI.–2.XII.1996, 2F1juv.A, 27.III.–4.IV.1997, 1ME 1M(im)2FA, leg. M. Snížek, FKCP. **Tanzania**: Tanga, 1FA, SMFD No. 6691/98; Mombasa, 9.–11.I.1996, 1M1FA, leg. M. Snížek, FKCP.

DIAGNOSTIC CHARACTERS. Total length of females 30–37 mm, males up to 42 mm due to longer metasoma. In contrast to female, male has fingers of pedipalps slightly twisted proximally. Sixth cutting edges on movable and fixed fingers of pedipalps each with two (or exceptionally one) external granules and sometimes also one internal granule (Figs 14 and 33). First and second metasomal segments with 10 keels, third and fourth segments with eight keels; third metasomal segment sometimes with two additional inconspicuous keels. Ventral surface of seventh mesosomal segment with two or four keels. For position and distribution of trichobothria on tibia of pedipalps see Fig. 73. Pectinal teeth number 16–20.

COMMENTS. I examined all specimens from the type series, one from Tanzania, one from Kenya, and two from Somalia, and designated them a lectotype and a paralectotypes Nos 1–3, respectively. This designates also the type locality.

Roewer (1943: 210) identified an SMFD specimen as a male, but the marked sexual dimorphism leaves no doubt that it is a female.

DISTRIBUTION. Kenya, Somalia, Tanzania (Kraepelin 1913: 175).

***Lychas perfidus* (Keyserling, 1885)**
(Figs 48, 78, 104, Tables 1–3)

Isometrus perfidus Keyserling, 1885: 15.

Archisometrus perfidus: Kraepelin, 1899: 47.

Lychas perfidus: Birula, 1917a: 105; Takashima, 1945: 80; L. B. Koch, 1977: 124; Kovařík, 1995: 189.

Archisometrus marmoreus (in part): Kraepelin, 1891: 226.

TYPE LOCALITY. Insel Viti Levu; BMNH.

TYPE MATERIAL. **Melanesia, Fiji**: Viti Levu Island, 1FA (lectotype), labeled: Keys., coll. Hamburg Mus., BMNH No. BM 1898.3.5.10.

OTHER MATERIAL. **Melanesia, Fiji**: Viti Levu Island, 20.II.1894, 2M1FA (males are immature), leg. Cpt. M. G. Pöhl, ZMUH.

DIAGNOSTIC CHARACTERS. Total length 30–40.6 mm. Sixth cutting edge on movable fingers of pedipalps with one external granule (Fig. 44), on fixed fingers with two external granules (Fig. 48). First and second metasomal segments with 10 keels, third and fourth segments with eight keels. Ventral surface of seventh mesosomal segment with four well developed keels. For habitus see Keyserling 1885, tab. II, fig. 2. For position and distribution of trichobothria on tibia of pedipalps see Fig. 78. Trichobothrium db is situated between trichobothria et and est. Legs, metasoma, and pedipalps are spotted. Pectinal teeth number 10–11 in females and 12 in the immature male. Subaculear tooth is very narrow (Fig. 104).

COMMENTS. This species is based on three specimens from Viti Levu Island, of which I examined and designated one as the lectotype.

DISTRIBUTION. Melanesia: Fiji, Viti Levu Island (Keyserling 1885: 16).

Lychas rackae sp. n.
(Figs 15, 34, 68, 83, Tables 1-3)

TYPE LOCALITY. India, Himalaya, Molta; ZMUH.

TYPE MATERIAL. India: Molta (Himalaya), 3000 m, 19. VI. 1956, 1MA (holotype), Deutsche Indien Expedition 1955-1957, Nr. 441, ZMUH No. ZMH 10.

ETYMOLOGY. Named after the German acarologist Mrs. Gisela Rack, who worked for 40 years as a curator at the Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany.

DESCRIPTION. The total length is 36.7 mm in the male holotype. The male has the fingers of pedipalps proximally twisted so that their edges cannot meet (Fig. 83). Although the female is unknown, I assume the same length of metasoma in both sexes. The habitus is shown in Fig. 68. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. Pectinal teeth number 16-17 in the male. For the position and distribution of trichobothria on the tibia of pedipalps see Fig. 83.

The base color is yellow, with brown spots.

The chelicera is reticulated and its fingers bear black spots.

The carapace is without keels but with large granules. It is yellow, with small and sparse black spots. There is a black spot around the median eyes and a black triangle between the median eyes and the anterior margin of the carapace.

The femur and tibia of pedipalps are yellow, dorsally and laterally with sparse brown spots. The ventral surface of the femur and tibia of pedipalps is yellow without spots. The fingers are yellow or yellowish brown. The patella of pedipalps is black both dorsally and ventrally, rarely with sparse minute yellow spots on the dorsal surface. The sixth cutting edges on the movable and fixed fingers of pedipalps bear one external granule each (Figs 15 and 34).

The mesosoma is spotted and bears one pronounced median keel and large granules (Fig. 68). The lower surface of the seventh segment bears four keels and a number of inconspicuous granules.

The legs have the same color pattern as the patella of pedipalps.

The metasoma is also spotted. The first through third segments bear but a few black spots, whereas the fourth and fifth segments have more of them, namely in the posterior half. There are 10 keels on the first segment and eight keels on the second through fourth segments. The second segment bears several granules indicating lateral keels. The dorsal keels terminate in a posterior tooth which is larger than that on each preceding segment. The subaculear tooth is pronounced, pointed, with one row composed of two granules in the upper midline.

AFFINITIES. The described features distinguish *L. rackae* sp. n. from all other species of the genus *Lychas*. They are recounted in the key below.

L. rackae sp. n. differs from *L. feae* (Myanmar, not included in the key) in the color of the manus of pedipalps, carapace, terga, and legs, which are black in *L. feae* (Pocock 1900: 42).

L. rackae sp. n. is close to *L. nigristeris*, from which it differs in sexual dimorphism. The male does not have a longer metasoma but, as in *L. mucronatus*, has the fingers of pedipalps proximally twisted so that their edges cannot meet. *L. mucronatus* has 10 keels on the second segment of the metasoma, whereas *L. rackae* sp. n. has only eight.

***Lychas rugosus* (Pocock, 1897)**
(Fig. 74, Tables 1-3)

Archisometrus rugosus Pocock, 1897: 111; Kraepelin, 1899: 48.

Lychas rugosus: Pocock, 1900: 39; Henderson, 1913: 130; Kraepelin, 1913: 133 (in part); Takashima, 1945: 80; L. E. Koch, 1977: 124; Kovařík, 1995: 189.

Lychas (Alterotrichus) rugosus: Tikader & Bastawade, 1983: 60; Bastawade, 1986: 636.

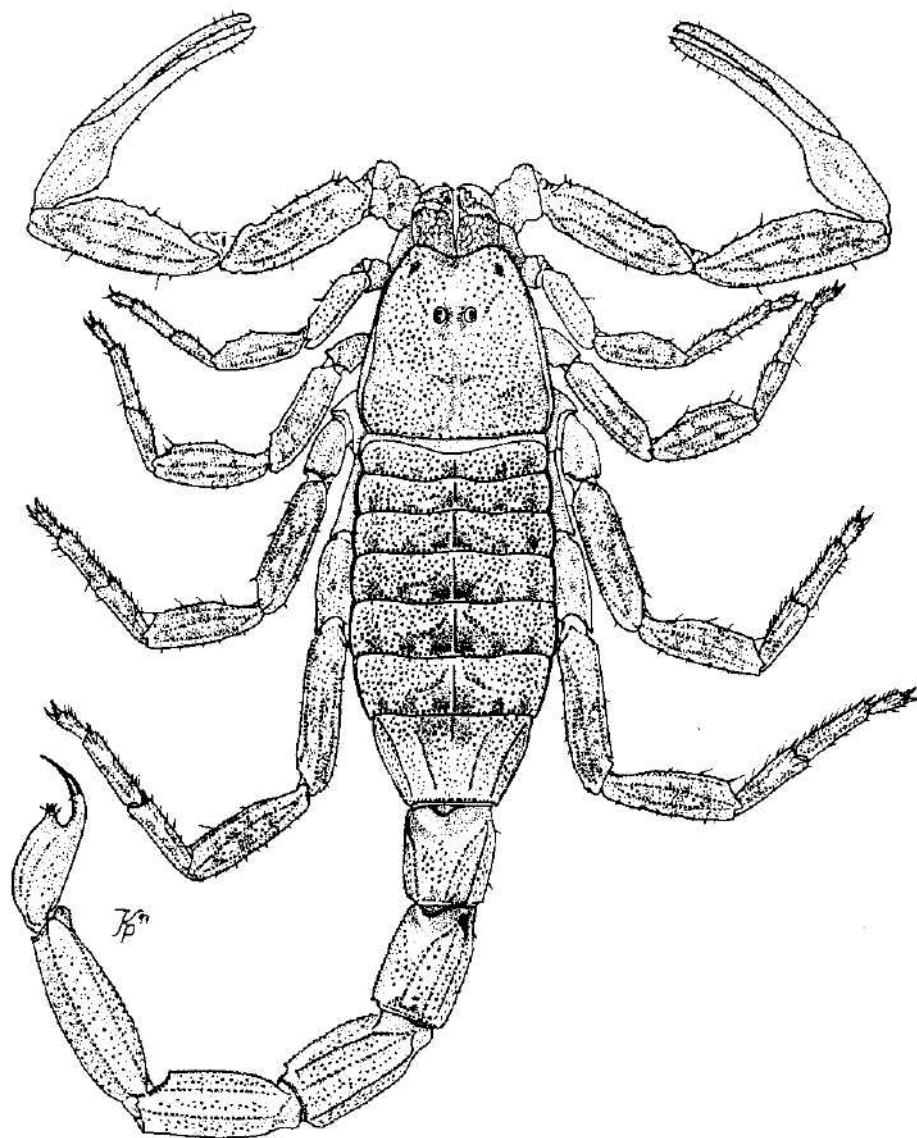


Fig. 106 – *Lychas lourencoi* sp. n., female HT. Dorsal aspect.

TYPE LOCALITY. India, Central Prov., Raipur; BMNH.

TYPE MATERIAL. India: Raipur, IMA (holotype), BMNH No. BM 1893.12.20.1.

DIAGNOSTIC CHARACTERS. Total length of male holotype 21.8 mm. Male has fingers of pedipalps slightly twisted proximally. Sixth cutting edge on movable finger of pedipalps without external and internal granules (Fig. 8). Dorsal as well as ventral surface of entire mesosoma covered by large granules. Ventral surface of seventh mesosomal segment with four conspicuous keels. For position and distribution of trichobothria on tibia, patella, and femur of pedipalps see Fig. 74 and Tikader & Bastawade 1983: 63, figs 165–169. First through third metasomal segments with 10 keels. Pectinal teeth number 12. Pecten in male holotype large, 0.8 mm wide and 1.9 mm long. Patella and femur of pedipalps predominantly dark, with few light spots. Fingers of tibia of pedipalps dark, manus light (Tikader & Bastawade 1983: 61, figs 154–157). For habitus see Tikader & Bastawade 1983: 61, fig. 154.

COMMENTS. Pocock based this species on a single male received from H. M. Phipson (Pocock 1897: 111). *L. rugosus* is the smallest species of the genus *Lychas*.

DISTRIBUTION. India (Pocock 1897: 111).

***Lychas scaber* (Pocock, 1893)**
(Figs 16, 35, 75, 97, Tables 1–3)

Isometrus (*Archisometrus*) *scaber* Pocock, 1893: 300.

Archisometrus scaber: Kraepelin, 1895: 86; 1899: 51.

Lychas scaber: Pocock, 1900: 38; Kraepelin, 1908: 190; 1913: 133; Roewer, 1943: 213; Takashima, 1945: 83; Caporin-acco, 1947: 248; L. E. Koch, 1977: 124; Kovarik, 1995: 189.

Lychas (*Endotrichus*) *scaber*: Tikader & Bastawade, 1983: 85.

TYPE LOCALITY. Madras; ? BMNH.

MATERIAL. India: Andhra Pradesh, Secunderabad, IMIFA, leg. A. Ricardo, BMNH No. 1893.3.16.7–8; Madras, IMA, MNHN No. RS 4501.

DIAGNOSTIC CHARACTERS. Total length ca 40 mm. Male differs from female by longer metasoma. Sixth cutting edges on movable and fixed fingers of pedipalps each with two external granules (Figs 16 and 35). First and second metasomal segments bear 10 keels, third and fourth segments bear eight keels. Ventral surface of seventh mesosomal segment bears two pronounced keels and two additional, inconspicuous keels indicated by sparse granules. For position and distribution of trichobothria on tibia and femur of pedipalps see Figs 75 and 97. Femur of pedipalps dorsally with sparse but pronounced granules, more so in central part. Sparse, but much larger granules scattered on dorsal surface of carapace and mesosoma. Patella of pedipalps dorsally with two well marked keels. Pectinal teeth number 17–20.

COMMENTS. Pocock (1893) mentioned only one female (the holotype) from Madras (Tamil Nadu prov.). This is a complete specimen 36 mm long. Tikader & Bastawade (1983: 91) regarded as type specimens one male and one female, BMNH No. 1893.3.16.7–8. They stated that the female lacks part of the metasoma. I have examined both specimens. The female lacks the third through fifth metasomal segments and the telson, and the male is heavily damaged. An enclosed label gives the locality of both specimens as "India: Secunderabad".

Considering the information provided in Pocock's (1893: 301) description, the male cannot be a type specimen, and the locality data and incompleteness of the female make it unlikely that this could be the holotype. According to Pocock the holotype has 17 and 18 pectinal teeth, whereas the examined female has 18 and 19.

The positions of trichobothria est, et and db, dt on the tibia of pedipalps do not correspond in either specimen examined to figs 234–239 of Tikader & Bastawade, although the authors (p. 91) state that the illustrations are of those specimens. Based on position of said trichobothria, Tikader & Bastawade placed this species in the subgenus *Endotrichus* instead of *Alterotrichus*. However, both subgenera have been synonymized (Kovářík 1995: 188).

DISTRIBUTION. India (Pocock 1893: 301).

Lychas scutillus C. L. Koch, 1845

(Figs 41, 47, 76, Tables 1–3)

Lychas scutillus C. L. Koch, 1845b: 3, fig. 962; 1850: 92; Pocock, 1900: 37; Kraepelin, 1905: 196; Henderson, 1913: 129; Roewer, 1943: 210; Takashima, 1945: 78; Caporacci, 1947: 248; L. E. Koch, 1977: 124; Vachon, 1985: 99; ? Khatoon, 1986: 645; Vachon, 1986: 841; Kovářík, 1995: 195.

Isometrus scutillus: Thorell, 1888: 337; Pocock, 1891: 435; 1893: 296.

Isometrus (Lychas) scutillus: Thorell, 1889: 525.

Lychas scutatus C. L. Koch, 1845b: 163 (content); Kraepelin, 1908: 186; 1913: 132; Kopstein, 1921: 121; 1923: 186; 1926: 111; Giltay, 1931: 18; Sachet, 1958: 6; Lamoral & Reynders, 1975: 511 (syn. by Pocock, 1900: 37).

Archisometrus scutatus: Thorell, 1893: 367; Kraepelin, 1895: 85; 1899: 44; 1901: 268; Vachon, 1986: 841.

Isometrus weberi Karsch, 1882: 184 (TL: Salanga) (syn. by Pocock, 1891: 435).

Archisometrus weberi: Kraepelin, 1891: 221; Vachon, 1986: 841.

Isometrus mesor Simon, 1884: 47 (TL: Java) (syn. by Pocock, 1891: 435).

Isometrus messor: Thorell, 1888: 337.

Lychas messor: Oates, 1888: 248; Vachon, 1986: 839.

Isometrus phipsoni Oates, 1888: 248 (TL: Tenasserim) (syn. by Pocock, 1891: 435).

Lychas phipsoni: Vachon, 1986: 839.

Archisometrus nigrimanus Kraepelin, 1898: 43 (TL: Sumatra); Kraepelin, 1899: 45. **Syn. n.**

Lychas nigrimanus: Kopstein, 1921: 122; 1923: 186; Giltay, 1931: 18; Takashima, 1945: 79; L. E. Koch, 1977: 124; Vachon, 1986: 839; Kovářík, 1995: 189.

TYPE LOCALITY. Ostindien, Insel Bintang; BMNH.

TYPE MATERIAL. **Indonesia**: Sumatra, 21.III.1897, 1FA (holotype of *Archisometrus nigrimanus*), ZMUH; Malakka, Salanga, 2FA (syntypes of *Isometrus weberi*), leg. Weber, ZMHB No. 4093.

OTHER MATERIAL. **Indonesia**: Sumatra, Deli, 1879, 1M1FA, leg. Schönherr, Mus. Frankfurt, ZMUH; Java, 1888, 1FA, det. M. Vachon 1975 No. VA-1310 as *Lychas scutatus*, NHMB No. 2a; Sumatra, 1M1FA det. M. Vachon 1975 as *Isometrus (Isometrus)* sp. ?, NHMB; Keeling Island, 1890, 1FA, leg. Kienberg, det. M. Vachon 1984 No. VA 2645, ZMUH; Billiton Island, 1892, 1MA, Mus. Leyden, det. M. Vachon 1984 No. VA 2641, ZMUH; Krapoh, 1893, 2M (one is immature) 1FA, Mus. Leyden, det. M. Vachon 1984 No. VA 2643, ZMUH; W. Sumatra, Bindjey Estah, W. Burchhard, 28.IV.1894, 1M1FA, ZMUH; Sumatra, Serdang, X.1894, 1M2FA, leg. O. Puttfarcken, det. M. Vachon 1984 No. VA 2639, ZMUH; 28.VIII.1902, 2FA, leg. Dr. Heinroth (labeled: *Lychas nigrimanus*), ZMHB No. 11341; Sumatra, Deli, 1FA, leg. Meissner (labeled: *Lychas nigrimanus*), ZMHB No. 11427; Sumatra, Deli, 1FA, SMFD No. 6689/96; Sumatra, 1MA (labeled: *Lychas weberi*), rev. M. Vachon 1981–82 No. VA 2652, ZMHB No. 7529; Sumatra, 1MA, leg. Virchow (labeled: *Lychas scutatus*), rev. M. Vachon 1981–82 No. VA 2654, ZMHB No. 7347; Ost-Sumatra, 1M1FA, ZMHB No. 894/09; Sumatra, 1FA, Mus. Berlin, det. M. Vachon 1984 No. VA 2654, ZMUH; Sumatra, Deli, Bandar Kivala, 2M1FA, leg. O. Puufarcken, ZMUH. **Malaysia**: Malacca, I–III.1909, 1M1FA, leg. Jachan (labeled: *Lychas flavimanus* – male, and *Lychas nigrimanus* – female), rev. M. Vachon 1981–82, Nos VA 2618–9, ZMHB No. 11350; Singapore, 1FA (labeled: *Lychas scutatus*), rev. M. Vachon 1981–82 No. VA 2653, ZMHB No. 7235; Malacca, Burton, 1MA, MNHN No. RS 1460; Singapore, 1M1FA, leg. Wang, MNHN Nos RS 4163 and 4167; Johore Baru Palm Garden, V.1967, 1juv.A, leg. Wang, MNHN No. RS 4558; Pangkor Island, 5.II.1995, 2FA, leg. S. Bečvář, FKCP; Kedah, Langkawi Island, 15.–17.VI.1995, 2M8F1juv.A, leg. S. & E. Bečvář, FKCP. **Myanmar**: Birma, Malawoon, 1885–1889, 1FA, leg. L. Foa, det. M. Vachon 1984 No. VA 2642, ZMUH. **Thailand**: NW Penins. Siam, Kapa, 1937, 1MA (labeled: *Archisometrus nigrimanus bernatziki* Schkl, typus), rev. M. Vachon 1975 No. VA-1311, leg. H. Bernatzik, NHMB No. 93.1.; Betong, IV.1993, 4F4ME 2FA, leg. J. Horák & J. Strnad, FKCP; Ko Lanta Island, 30 km Trang, 5.V.1996, 1MA, leg. J. Vondráček, FKCP; Khao Sok, II.1997, 2FA, leg. O. Bužga, FKCP. ? East Asia Expedition, 1MA (labeled: *Lychas weberi*), ZMHB No. 7537; East Asia, 1MA (labeled: *Lychas scutatus*), rev. M. Vachon 1981–82 No. VA 2651, ZMHB No. 7387. ? labelled “Zanzibar”, 1FA, No. 2881, det. Kraepelin 1891, det. M. Vachon 1984 No. VA 2640, ZMUH.

DIAGNOSTIC CHARACTERS. Total length 60–86.5 mm in males and 40–65 mm in females. Male differs from female by much longer, very thin metasoma and long telson (Table 1). Sixth cutting edges on movable and fixed fingers of pedipalps each with three to five external granules and one or no internal granule (Figs 40, 41, and 47). Ventral surface of seventh metasomal segment bears four pronounced keels. First segment of metasoma has 10 keels, second through fourth segments have eight keels. For position and distribution of trichobothria on tibia of pedipalps see Fig. 76.

Base color is yellow to reddish brown. Tibia, in part patella of pedipalps, telson, fifth and occasionally also fourth metasomal segments are dark brown. Mesosoma is spotted. Pectinal teeth number 15–20.

COMMENTS. *L. scutillus* was designated the type species of the genus *Lychas* (Pocock 1899: 834; Kovařík 1995: 188).

I examined the syntypes of *Isometrus weberi* (Table 1) and the holotype of *Archisometrus nigrimanus*. Although it has never been published that *Archisometrus nigrimanus* is a synonym of *L. scutillus*, the specimen labels show that this fact was known already to Kraepelin and Vachon. One holotype label says “= *Lychas scutatus* C. L. Koch, 1845, Kraepelin det.”, and a second label states “= *Lychas scutillus* C. L. Koch, 1845, Vachon det. 1984”. Vachon also enclosed his code number VA-2644.

The holotype of *Archisometrus nigrimanus* is 50.4 mm long and has 15 and 17 pectinal teeth. **DISTRIBUTION.** Indonesia (C. L. Koch 1845b: 5), Malaysia (Pocock 1900: 38), Myanmar (Oates 1888: 248), Thailand (Kraepelin 1891: 222).

The species was mistakenly recorded from Zanzibar (see “Other material” and Kraepelin 1891: 222) and the Congo (Kraepelin 1899: 45). Its record from Pakistan, Daman-e-koh, Islamabad (Khatoon 1986: 645), is due to known distribution also to be regarded as incorrect.

***Lychas serratus* (Pocock, 1891)**

(Table 2)

Isometrus serratus Pocock, 1891: 441.

Archisometrus serratus: Kraepelin, 1895: 85; 1899: 45.

Lychas serratus: Kovařík, 1995: 190.

TYPE LOCALITY. Mauritius, Round Island; BMNH.

DIAGNOSTIC CHARACTERS. Length of male holotype without vesicle 54 mm. Male has fingers of pedipalps proximally twisted so that their edges cannot meet (Pocock 1891, pl. 11, fig. 4a). Female unknown, but it is assumed that male has longer metasoma. First metasomal segment bears 10 keels, second through fourth segments bear eight keels (Pocock 1891: 442). Number of pectinal teeth unknown (Pocock 1891: 442). For habitus of holotype see Pocock, pl. 11, fig. 4.

COMMENTS. The species is based on a dry-mounted incomplete male lacking pectines and vesicle (Pocock 1891: 442). Unfortunately, I have not been able to examine the holotype or any other specimens of this species, and the diagnostic characters are therefore based solely on Pocock's description. However, Pocock gives neither the number of granules on the sixth cutting edge of the movable fingers of pedipalps, nor the position and distribution of trichobothria on the pedipalps. I am therefore unable to include this species in the key below, although I am convinced that it is a valid species. No specimens apart from the holotype are known.

DISTRIBUTION. Mauritius (Round Island) (Pocock 1891: 443).

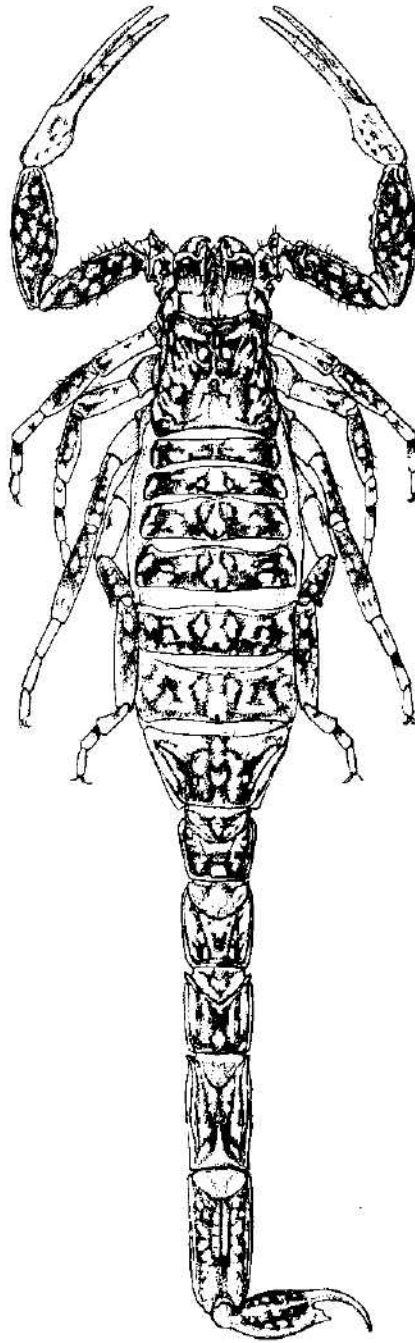


Fig. 107 – *Lychas variatus* (Thorell), female from FKCP. Dorsal aspect.

***Lychas shelfordi* (Borelli, 1904)**
(Figs 45, 51, 77, Tables 1–3)

Archisometrus shelfordi Borelli, 1904: 1.

Lychas shelfordi: Kopstein, 1921: 125; 1923: 186; Giltay, 1931: 18; Takashima, 1945: 83; L. E. Koch, 1977: 124; Vachon & Lourenço, 1985: 9; Vachon, 1986: 839; Kovářik, 1994: 197; 1995: 190.

TYPE LOCALITY. Sarawak, Kuching; MRSN.

TYPE MATERIAL. **Malaysia**: Sarawak, Kuching, 1MA (lectotype) 1FA (paralectotype No. 1), leg. R. Shelford, MRSN No. Sc. 313.

OTHER MATERIAL. **Indonesia**: Sulawesi, 30 km W of Kendari, 11.–14.II.1994, 1FE, leg. Štrba & Jeniš, FKCP. **Malaysia**: Sarawak, Kuching dist., Mt. Penrissen, 1000 m above sea level, 24.–26.III.1994, 1FE, leg. J. Horák, FKCP. **Philippines**: Luzon, Los Baños, 23.IV.1914, 1M2FA (and one ecdysis), leg. S. Böttcher & V. Heyne, ZMHB No. 137D/24; Luzon, Banakao, 2000 m, 25.IV.1914, 1M1FA, leg. S. Böttcher & V. Heyne, ZMHB No. 137D/24; Insel Basilan, 8.XII.1914, 1FA, leg. S. Böttcher & V. Heyne, ZMHB No. 137D/24; Insel Samav, Sabbalogan, IV.1915, 1MA, leg. S. Böttcher & V. Heyne, ZMHB No. 137D/24; N. Mindanao, Surigao, V.1915, 1M2F2juvsA, leg. S. Böttcher & V. Heyne, ZMHB No. 137D/24; N. Mindanao, Kolambugan, 1MA, leg. S. Böttcher & V. Heyne, ZMHB No. 137D/24; Sabaan, 23.I.1916, 1FA, leg. S. Böttcher & V. Heyne, ZMHB No. 137D/24; Suboa, 31.I.1916, 1juv.A, leg. S. Böttcher & V. Heyne, ZMHB No. 137D/24; N. Luzon, Prov. Kalinga, Balbalan, 4000 m, VIII.1918, 1MA, leg. S. Böttcher & V. Heyne, ZMHB No. 137D/24; Palawan Island, Quezon env., V.1980, 1M2FA, FKCP; Busuanga Island, V.1980, 1MA, FKCP.

DIAGNOSTIC CHARACTERS. Total length 30–44.5 mm. Male differs from female in having longer metasoma. Sixth cutting edge on movable finger of pedipalps with one external granule, and on fixed finger with one (Figs 45 and 51) or two external granules.

First metasomal segment bears 10 keels, second through fourth segments bear eight keels. Very rarely (only two examined specimens from Philippines) 10 keels on second metasomal segment. Ventral surface of seventh metasomal segment without keels but with large, mutually isolated granules. For position and distribution of trichobothria on pedipalps see Fig. 77. Pectinal teeth number 11–14.

Color pattern spotted (including telson and legs). Femur and patella of pedipalps largely dark brown. Tibia shiny and yellow, with sparse, minute dark spots.

COMMENTS. The species is based on one male and two females. I examined one male and one female and designated them a lectotype and a paralectotype No. 1, respectively. Both specimens were studied by Vachon, who did not designate a lectotype, however.

DISTRIBUTION. Indonesia: Sulawesi (first report), Malaysia: Sarawak (Borelli 1904: 3), and Philippine Islands (Giltay 1931: 18–19).

***Lychas shoplandi* (Oates, 1888)**
(Figs 17, 36, 84, 94, Tables 1–3)

Isometrus shoplandi Oates, 1888: 246; Thorell, 1889: 562; Pocock, 1891: 434 (in part); 1893: 303.

Archisometrus shoplandi: Kraepelin, 1891: 225; 1895: 86; 1899: 50.

Lychas shoplandi: Pocock, 1900: 41; ? Kraepelin, 1913: 133; Takashima, 1945: 83; L. E. Koch, 1977: 124; Vachon, 1982: 86; 1986: 839; Kovářik, 1995: 190.

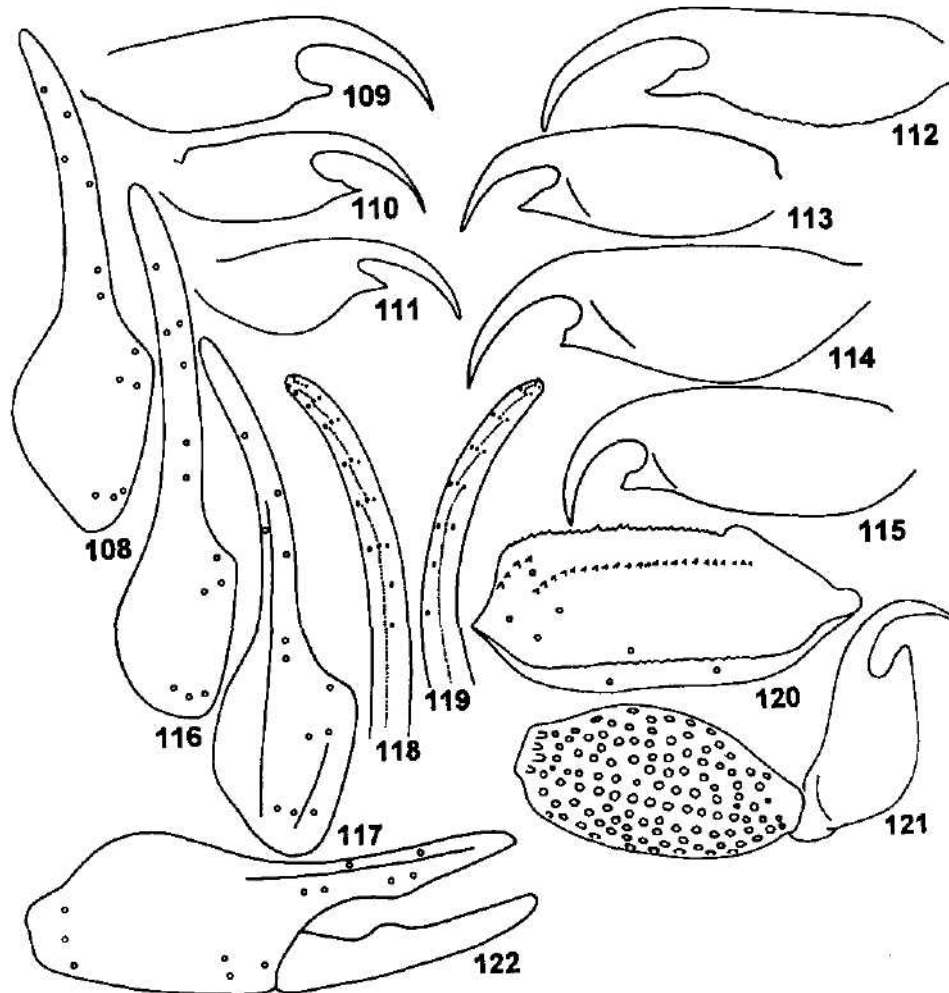
TYPE LOCALITY. Burma, Palone, a village about 50 miles N of Rangoon; BMNH.

TYPE MATERIAL. **Myanmar**: Palone, a village about 50 miles N of Rangoon, 1FA (lectotype) 1juv.A (paralectotype No. 1), BMNH No. 1897.5.10.1–2.

OTHER MATERIAL. **Myanmar**: Palon, 20.X.1896, 3juvsA, leg. L. Foa, ZMUH.

DIAGNOSTIC CHARACTERS. Total length 50–58 mm. Sixth cutting edges on movable and fixed fingers of pedipalps without external and internal granules (Figs 17 and 36). First through third

metasomal segments bear 10 keels and fourth segment bears eight keels, but two keels on third segment are less conspicuous. Ventral surface of seventh segment bears four conspicuous keels. Fingers are much lighter-colored than manus of pedipalps. For position and distribution of trichobothria on tibia and patella of pedipalps see Figs 84 and 94. Pectinal teeth number 21–25.



Figs 108–122. Fig. 108 – *Lychas buchari* sp. n., male HT, tibia of pedipalps. Figs 109–116 – telson. Fig. 109 – *L. marmoreus* (C. L. Koch), female LT of *L. marmoreus splendens* Kraepelin. Figs 110–111 – *L. variatus* (Thorell). Fig. 110 – LT of *L. marmoreus kimberleyanus* Kraepelin. Fig. 111 – female LT of *L. spinatus* Kraepelin. Figs 112–115 – *L. asper* (Pocock). Fig. 112 – female from BMNH. Fig. 113 – male from MNHN. Fig. 114 – female LT of *L. asper obscurus* Kraepelin. Fig. 115 – male from MNHN. Fig. 116 – *L. hendersoni* (Pocock), female HT, tibia of pedipalps. Figs 117–121 – *Hemilychas alexandrinus* Hirst, male HT. Fig. 117 – tibia of pedipalps. Fig. 118 – movable finger of pedipalps. Fig. 119 – fixed finger of pedipalps. Fig. 120 – femur of pedipalps. Fig. 121 – telson and fifth metasomal segment. Fig. 122 – *Lychas farkasi* sp. n., male HT, chela of pedipalps.

COMMENTS. Since Oates did not establish a holotype, I designate a lectotype (Table 1) and a paralectotype No. 1. Oates noted that the male is not known, and no later author mentioned a male. Thorell recorded another female from "Prome" (Myanmar). Oates counted 22 pectinal teeth (paralectotype No. 1). Thorell (1889: 562–566) gave a total length of ca 52 mm and 22–25 pectinal teeth. Pocock (1900: 41) gave a total length of 58 mm. Examined juveniles from ZMUH measure 27–30 mm.

Kraepelin (1913: 133) stated that mesosomal segments bear three keels, but I have found only one dorsal keel on the second through sixth mesosomal segments of all examined specimens, including the types. Kraepelin used this character to distinguish *L. shoplanti* from *L. feae*, which is also listed from Myanmar.

DISTRIBUTION. Myanmar (Oates 1888: 247).

***Lychas tricarinatus* (Simon, 1884)**
(Figs 46, 53, 85, 100, Tables 1–3)

Isometrus tricarinatus Simon, 1884: 47; Oates, 1888: 247; Pocock, 1891: 433; 1893: 303.

Archisometrus tricarinatus: Kraepelin, 1891: 227; 1895: 86; 1899: 50; 1901: 268.

Lychas tricarinatus: Pocock, 1900: 40; Kraepelin, 1908: 190; 1913: 133; Henderson, 1919: 380; Werner, 1916: 86; Lampe, 1918: 195; Werner, 1934: 271; Roewer, 1943: 210; Takashima, 1945: 83; Basu, 1964: 103; Sreenivasa-Reddy, 1968: 760; Mathew, 1970: 123; Lamoral & Reynders, 1975: 512; Polis & Sissom, 1990: 174; Kovařík, 1995: 190.

Lychas (Endotrichus) tricarinatus: Tikader & Bastawade, 1983: 73.

TYPE LOCALITY. Pondichery; MNHN.

TYPE MATERIAL. India: Pondichery, IFA (lectotype), MNHN No. RS 1477, 5374.

OTHER MATERIAL. India: Dekan, Anamalci, IFA, SMFD No. 1085/16; Dharwar, Hubbli, IFA, leg. Ziegler, NHMB No. 3a; Madras, Vellon, 1890, IFA, ZMUH; Ostindien, 20.VIII.1900, IFA, "Mus Paris", ZMUH; Sa San, Kathiawar, 3FA, "Mus Calcutta", ZMUH; X.1912, IFA, Mus. Calcutta, ZMUH; Inde or., IFA, MNHN No. RS 1450, 1F(im)A, coll. Simon, MNHN No. RS 1492; Andhra Pradesh, Tirumalai Hills, Tirupati, IFA, MNHN No. RS 4500, 3FA, MNHN No. RS 7154, 1juv.A, MNHN No. RS 7155; Chokardharpur, Nagpur, IFA, "Mus Calcutta", ZMUH; 1FB1MA, FKCP. ?; 5F1juv.A, MNHN Nos 1467 and 7153.

DIAGNOSTIC CHARACTERS. Total length 44–54.7 mm. Male differs from female in longer and narrower metasomal segments (Tab. 1). Sixth cutting edge on movable fingers of pedipalps without external and internal granules (Figs 46 and 53). Second through sixth mesosomal segments usually with three carinae, but in some specimens with only one carina. First and second metasomal segments bear 10 keels, of which two keels are composed of well defined but mutually more distant granules. Third and fourth metasomal segments bear eight keels, but third segment may have 10 keels. For position and distribution of trichobothria on tibia and femur of pedipalps see Figs 85 and 100. Trichobothrium esb1 on patella of pedipalps is situated between trichobothria esb2 and eb (Fig. 93). Tibial spurs are markedly long.

Base color is yellow, with dark brown spots. Fingers and manus of tibia of pedipalps are of identical color, light and spotted. Pectinal teeth number 20–26.

COMMENTS. The type material in Simon's collection is not unequivocally labeled. Tikader & Bastawade (1983: 78) stated that they had examined three females, BMNH No. 1894.10.24. Simon (1884: 47) described a female from Pondichery with a total length of 38 mm and 25 pectinal teeth, which according to him is deposited in the Simon collection and thus at MNHN. Although the examined female, MNHN No. RS 1477, is 44.3 mm long, it agrees with Simon's description in the number of pectinal teeth and the locality, for which reason I hereby designate is the lectotype.

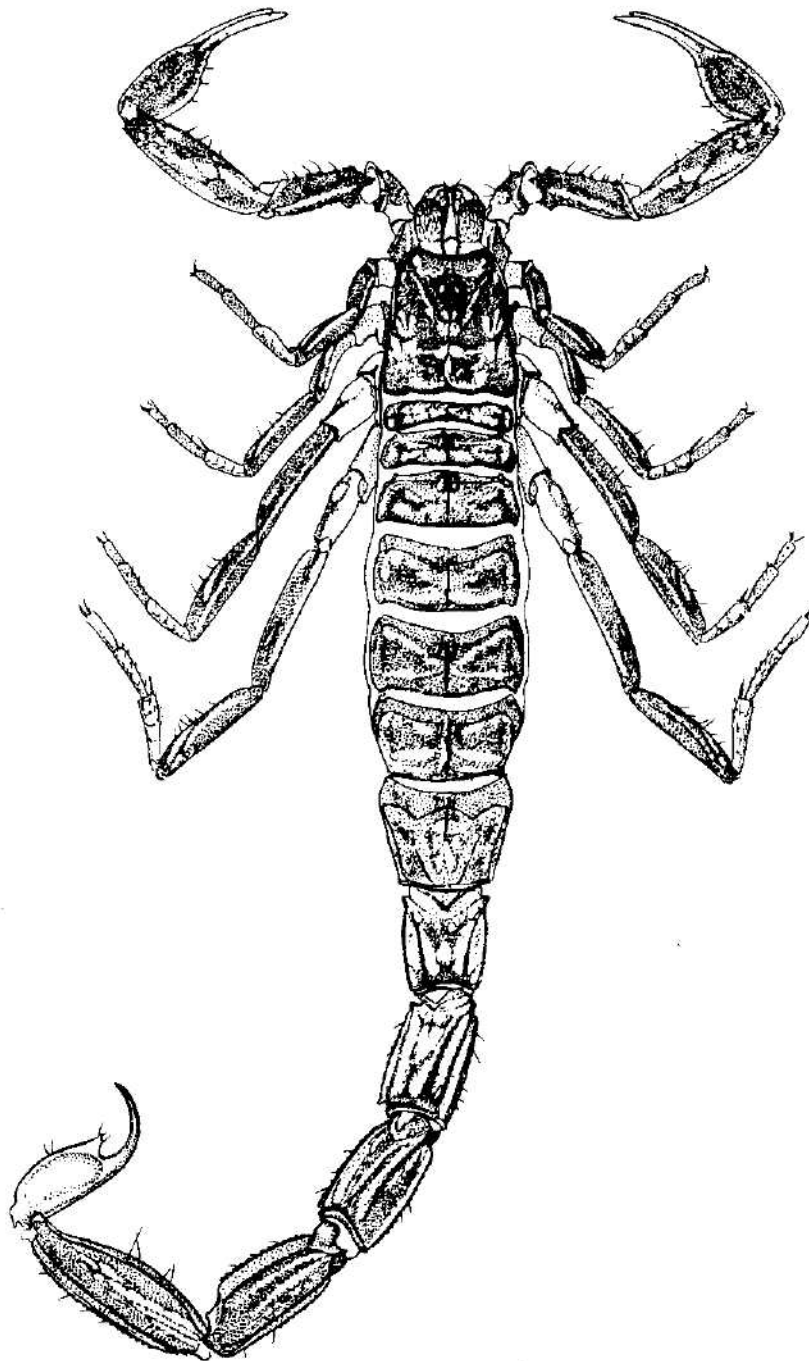


Fig. 123 – *Lychas heurtaultae* sp. n., male HT. Dorsal aspect.

DISTRIBUTION. India (Simon 1884: 47). This species was mistakenly recorded from West Africa, Slave Coast (Kraepelin 1891: 227–228).

***Lychas variatus* (Thorell, 1876)**

(Figs 19–21, 38, 39, 90, 91, 101, 102, 107, 110–111, Tables 1–3)

Isometrus variatus Thorell, 1876: 136; Keyserling, 1885: 9; Thorell, 1888: 407.

Archisometrus variatus: Kraepelin, 1899: 49; 1901: 268.

Lychas variatus: L. E. Koch, 1977: 132; 1981: 877; Locket, 1990: 79; ? Sissom, 1990: 92; Locket, 1993: 597; Kovařík, 1995: 190.

Archisometrus marmoreus: Kraepelin, 1891: 226 (in part); 1899: 49 (in part).

Lychas marmoreus: Kraepelin, 1908: 87 (in part); 1916: 26 (in part); Glauert, 1925: 95 (in part).

Lychas marmoreus variatus: Kraepelin, 1916: 28; Glauert, 1925: 98; Takashima, 1945: 81; Glauert, 1963: 183.

Isometrus thorellii Keyserling, 1885: 12 (TL: Sydney); Thorell, 1888: 407 (syn. by L. E. Koch, 1977: 132).

Isometrus variatus var. *papuanus* Thorell, 1888: 407 (TL: Sydney) (syn. by L. E. Koch, 1977: 132).

Lychas papuanus: Kraepelin, 1916: 29; Kopstein, 1921: 124; 1923: 184; Glauert, 1925: 99; Giltay, 1931: 18.

Lychas marmoreus papuanus: Takashima, 1948: 74; 1950: 19.

Isometrus armatus Pocock, 1891: 439 (TL: Australia, Port Essington) (syn. by L. E. Koch, 1977: 132).

Archisometrus armatus: Kraepelin, 1895: 85; 1899: 47.

Lychas armatus: Glauert, 1925: 100; Takashima, 1945: 79; Glauert, 1954: 5.

Lychas marmoreus kimberleyanus Kraepelin, 1916: 29 (TL: Australia, Kimberley District); Glauert, 1925: 98; Takashima, 1945: 81; Glauert, 1963: 183 (syn. by L. E. Koch, 1977: 133).

Lychas spinatus Kraepelin, 1916: 32 (TL: Australia: Queensland); Glauert, 1925: 102; Takashima, 1945: 84 (syn. by L. E. Koch, 1977: 133).

Lychas spinatus spinatus: Glauert, 1925: 103.

Lychas spinatus var. *besti* Glauert, 1925: 103 (TL: Australia: Mallee District of Victoria); Takashima, 1945: 84 (syn. by L. E. Koch, 1977: 133).

Lychas spinatus var. *pallidus* Glauert, 1925: 105 (TL: Australia: New South Wales); Takashima, 1945: 84 (syn. by L. E. Koch, 1977: 133).

Lychas lappa Glauert, 1954: 4 (TL: Australia: North Queensland, Lappa junction); L. E. Koch, 1980: 296 (syn. by L. E. Koch, 1977: 133).

TYPE LOCALITY. Nova Hollandia; MCSN.

TYPE MATERIAL. **Australia**: Queensland, IX.1911, 2FA (lectotype and paralectotype of *Lychas spinatus*), ZMUH No. 479; Kimberley District, 1912, 2juvsA (lectotype and paralectotype No. 1 of *Lychas marmoreus kimberleyanus*), leg. Mjöberg, ZMUH No. 456. **New Guinea**: Yule island, 1875, 2FA (lectotype and paralectotype No. 1 of *Isometrus variatus papuanus*), leg. L. M. D'Albertis, MCSN.

OTHER MATERIAL. **Australia**: Queensland, IFA, MNHN No. RS 7337; Rockhampton, IFA, MNHN, No. RS 1464; Queensland, Blackall Range, VIII.1912, 2FA, leg. Mjöberg, ZMUH; Broome, VIII.1912, 1FA, leg. Mjöberg, ZMUH; S. Queensland, Mt. Tamborine, VII.1914, 1FA, leg. Mjöberg, ZMUH; S. Queensland, Herberton, VII.1914, 1FA, leg. Mjöberg, ZMUH; S. Queensland, Christmas Creek, VII.1914, 1MIFA, leg. Mjöberg, ZMUH; Queensland, IFA (det. P. Hillyard as *Lychas armatus* and L. E. Koch as *Lychas variatus*), BMNH No. BM 1924.9.1.1; Queensland, Varia, 1968, 2juvsA, leg. J. Balogh, Hung. Soil. Zool. Exp., HNHM No. QLD.C.1; 1969, IMA, leg. J. Balogh, HNHM No. AA-S.3; Queensland, near Canberra (?), 1972, 1juv.A, leg. H. Strümpel, ZMUH No. A67/79; Queensland, 1980, 1juv.A, FKCP; South, Adelaide, IMA, leg. Schemburgh, labeled: *Lychas armatus*, ZMHB No. 7593; Thursday, IFA, MNHN No. RS 1461. **Melanesia**: Solomon Islands, New Georgia Island, Rubiana, IMA, coll. A. Willey, BMNH. **New Guinea**: 5.XII.1899, IFA, Mus. Genue, ZMUH; Kaiskrim, 2–5.XI.1912, IFA, No. 353/1913, VII.1912, IFA, No. 1431/1912, 28.VIII.1912, IMA (im), No. 1431/1912, 24.VII.1912, IFA, No. 1431/1912, IFA, No. 1016/1912, leg. Bürgers, ZMHB; NNW, X.1912, 1MIFA, leg. P. N. Kampen, ZMUH; Siwi, 1980, IFE, FKCP; Cyclop, 1980, IFE, FKCP; 1980, IFA, FKCP.

DIAGNOSTIC CHARACTERS. Total length 36–50.5 mm. Sixth cutting edges on movable and fixed fingers of pedipalps each with one (Figs 19 and 38), two (Figs 20, 21, and 39) or three external granules. Male has fingers of pedipalps proximally twisted. First metasomal segment with 10 keels, second and third segments with 10 or eight keels. Dorsal keels on second through fourth metasomal segments terminate in a tooth, which is particularly conspicuous on the third meta-

somal segment of adult males. Subaculear tooth large, wide, and pointed (Figs 110–111). For position and distribution of trichobothria on tibia and femur of pedipalps see Figs 90–91 and 101–102. Position of trichobothrium db varies (Figs 90 and 91). Nearly entire animal is spotted, fingers and manus of pedipalps are of uniform color or fingers are lighter than manus of tibia (Fig. 108 and pl. 2, fig. 3 in Pocock 1891). Fingers may be rarely darker than manus. Pectinal teeth number 12–24 in males and 10–24 in females. The habitus is shown in Fig. 107.

COMMENTS. Thorell (1876) based the species on one specimen 39 mm long and with 17 pectinal teeth, from “Nova Hollandia”.

This species is very similar to *L. marmoreus* with which it is often confused (e. g. Kraepelin 1916: 29, Glauert 1925: 95). *L. variatus* was revised by L. E. Koch (1977: 135), who examined 71 males and 187 females. He counted 12–24 pectinal teeth in the males and 10–24 in the females.

L. variatus is very variable in the number of pectinal teeth as well as in other characters commonly used to distinguish species of the genus *Lychas*, such as the position of trichobothria on the tibia of pedipalps (Figs 90 and 91), the presence of 10 but sometimes only eight keels on the second and third metasomal segments, and the number of external granules near the sixth granular row on the movable and fixed fingers of pedipalps. This variability has led to descriptions of many subspecies. I agree with L. E. Koch, who considers all the subspecies invalid.

In addition, I have examined the following type material:

1) The types of *L. spinatus* (Table 1), hereby designated the lectotype and paralectotype with total lengths of 46.4 and 46.6 mm, respectively. Pectinal teeth number 19 in the lectotype and 19 and 20 in the paralectotype.

2) The types of *Lychas marmoreus kimberleyanus* (Figs 19, 38, 91, 102, and 110), hereby designated a lectotype and a paralectotype No. 1. They are immature specimens. According to the original label, Kraepelin at first correctly identified them as *L. variatus*, but later called them *L. thorelli* and subsequently *L. m. kimberleyanus*. The lectotype is 20 mm long and has 16 pectinal teeth. The paralectotype No. 1 is 13.5 mm long and has 13 and 14 pectinal teeth.

3) The types of *Lychas variatus papuanus*, hereby designated a lectotype and a paralectotype No. 1, with total lengths of 50.5 and 33.5 mm, respectively. Pectinal teeth number 15 and 16 in the lectotype and 14 in the paralectotype No. 1.

DISTRIBUTION. Australia (Thorell 1876: 138), Melanesia: Solomon Islands, Bougainville Island (L. E. Koch 1977: 138), and New Guinea (Kopstein 1921: 124). For distribution of *L. variatus* in Australia and New Guinea see L. E. Koch 1977: 312, map 3.

Key to *Lychas* species occurring in the Oriental region, Australia, incl. Melanesia (except *L. feae*)

1. Sixth cutting edge on movable fingers of pedipalps with external granules (Fig. 10). 2
- Sixth cutting edge on movable fingers of pedipalps without external granules (Fig. 8). 21
2. Second segment of metasoma with 10 keels (some specimens from Australia and New Guinea may have two keels only vestigial or rarely absent). 3
- Second segment of metasoma with eight keels (absent in Australia and New Guinea). 14
3. Sixth cutting edge on movable fingers of pedipalps with one external granule. Some specimens from Australia and New Guinea may have two (Figs 20–21) or very rarely three (*L. variatus*) external granules, in which case their third metasomal segment usually bears 10 keels). 4
- Sixth cutting edge on movable fingers of pedipalps with two to four external granules (Fig. 10). Third metasomal segment with eight keels (absent in Australia and New Guinea). 11
4. Dorsolateral keels of metasomal segments composed of granules of equal size. Keels do not terminate in a conspicuous tooth. Third metasomal segment with eight keels. Absent in Australia and New Guinea. 5

- Dorsolateral keels of second and third metasomal segments terminate in a tooth (very conspicuous in adult males) which may be blunt. Third metasomal segment with 10 keels (some specimens may have two keels on the second and third metasomal segments only vestigial or rarely absent). Occurs in Australia and New Guinea. 6
- 5. Tibial spurs on third and fourth legs long. 8
- Tibial spurs on third and fourth legs short. *L. gravelyi* Henderson
- 6. Subaculear tooth small (Fig. 105). *L. mjobergi* Kraepelin
- Subaculear tooth conspicuous (Figs 109–111). 7
- 7. Subaculear tooth wide, tall, and usually pointed (Figs 110–111), with granules always present. Female has metasoma as long as male. Metasoma not very slender, third metasomal segment length to width ratio lower than 1.6. Fingers and manus of pedipalps spotted and of the same color, or fingers lighter than manus (Fig. 108 and pl. 2, fig. 3 in Pocock 1891). *L. variatus* (Thorell)
- Subaculear tooth not as wide and terminally rounded (Fig. 109), with or without granules. Male has longer metasoma than female. Metasoma very slender, third metasomal segment length to width ratio higher than 1.7. Manus of pedipalps light-colored and spotted, fingers dark (fig. 868 in C. L. Koch, 1844). *L. marmoreus* (C. L. Koch)
- 8. First metasomal segment longer than wide. 10
- First metasomal segment wider than long. 9
- 9. Subaculear tooth wide (Fig. 103), with granules. Trichobothrium db situated between trichobothria dt and et (Fig. 69). *L. infuscatus* (Pocock)
- Subaculear tooth narrow (Fig. 104), without granules. Trichobothrium db situated between trichobothria et and est (Fig. 78). *L. perfidus* (Keyserling)
- 10. Pectinal teeth number 11–14. *L. shelfordi* (Borelli)
- Pectinal teeth number 26. *L. buchari* sp. n.
- 11. Legs uniformly colored. *L. scaber* Pocock
- Legs spotted (Fig. 106). 12
- 12. Pectinal teeth number 11–12. *L. lourencoi* sp. n.
- Pectinal teeth number 15–26. 13
- 13. Manus of pedipalps of the same color as patella and femur of pedipalps. Total length 30.4–44.5 mm. Pectinal teeth number 10–19. Metasoma much longer in male than in female. *L. krati* Kovarik
- Manus of pedipalps bright yellow (with sparse, minute black spots), patella predominantly dark. Total length 40–65 mm. Pectinal teeth number 16–26 (most frequently 19–22). Metasoma of approximately the same length in both sexes. *L. mucronatus* (Fabricius)
- 14. Third metasomal segment with eight keels. 15
- Third metasomal segment with six keels. *L. kharpadi* Bastawade
- 15. Sixth cutting edge on movable fingers of pedipalps with one external granule (Fig. 9). 16
- Sixth cutting edge on movable fingers of pedipalps with three to five external granules (Figs 40 and 41). 18
- 16. Pectinal teeth number 11–13, rarely 14 (only males). Occurs in Indonesia, Malaysia, and Philippines. *L. shelfordi* (Borelli)
- Pectinal teeth number 15–18, rarely 14 (only females). Occurs in India and Nepal. 17
- 17. Patella dark, occasionally with a few light spots, darker than femur and tibia of pedipalps. 20
- Patella light-colored, with a few dark spots, of the same color as femur and tibia of pedipalps. *L. hillyardi* sp. n.
- 18. Femur and patella dark, manus of pedipalps yellow. 19
- Femur and adjoining half of patella yellowish brown, rest of patella and manus dark. Fingers reddish brown, lighter than manus. *L. scutius* C. L. Koch
- 19. Trichobothrium db situated between trichobothria dt and et (Fig. 64). Pectinal teeth number 18–24. Legs not spotted. *L. hovei* (Pocock)
- Trichobothrium db situated between trichobothria et and est (Fig. 62). Pectinal teeth number 15–19. Legs may be spotted. *L. flavimanus* (Thorell)
- 20. Manus narrow. Tibia length to manus width ratio higher than 4.7. *L. nigristeris* (Pocock)
- Manus wide. Tibia length to manus width ratio lower than 4.2. *L. rackae* sp. n.
- 21. Pectinal teeth number 12–18. 22
- Pectinal teeth number 20–26. 23
- 22. Pectinal teeth number 12. Fingers dark, manus of tibia of pedipalps light. *L. rugosus* (Pocock)
- Pectinal teeth number 17–18. Fingers and manus of tibia of pedipalps of the same color. *L. hendersoni* (Pocock)
- 23. Fingers lighter-colored than manus of tibia of pedipalps. 24
- Fingers of the same color as, or darker than, manus of tibia of pedipalps. 25
- 24. Third metasomal segment with 10 keels. *L. shoplandi* (Oates)
- Third metasomal segment with eight keels. *L. heurtaultae* sp. n.
- 25. Pectines six times longer than wide, pectinal teeth number 24. *L. biharensis* Tikader & Bastawade

- Pectines less than five times longer than wide, pectinal teeth number 20–25. 26
- 26. Pectinal teeth number 20. Total length under 30 mm. *L. kamshetensis* Tikader & Bastawade
- Pectinal teeth number 21–25. Total length over 30 mm. 27
- 27. Fingers and manus of tibia of pedipalps of the same color, light and spotted. 28
- Manus of pedipalps light, fingers dark. *L. albimanus* Henderson
- 28. Triangle between median eyes and anterior margin of carapace glossy and smooth or tuberculate, without granules which cover other areas of carapace. *L. laevifrons* (Pocock)
- Entire carapace evenly granulated. 29
- 29. Manus of pedipalps granulated. *L. farkasi* sp. n.
- Manus of pedipalps smooth without granules. *L. tricarinatus* (Simon)

Key to *Lychas* occurring in Africa and the Seychelles

1. Sixth row of granules (cutting edge) on movable finger with external granules (Fig. 2). Male has metasoma longer than female. 2
- Sixth row of granules on movable finger without external granules (Fig. 3). Female has metasoma as long as male. 3
2. Terminal tubercle of each dorsal keel on second and third metasomal segments markedly enlarged (Fig. 55). Manus of pedipalps dark. *L. obsti* Kraepelin
- Terminal tubercle of each dorsal keel scarcely larger than others (Fig. 54). Manus of pedipalps light, with dark spots. *L. asper* (Pocock)
3. Dorsal surface of mesosoma with three keels. Seventh segment of mesosoma with four pronounced ventral keels. Fifth segment of metasoma smooth and glossy. *L. braueri* (Kraepelin)
- Dorsal surface of mesosoma with one keel. Seventh segment of mesosoma ventrally smooth and without keels. Fifth segment of metasoma not glossy. *L. burdoi* (Simon)

Checklist of the genus *Lychas* C. L. Koch, 1845

Lychas albimanus Henderson, 1919
Lychas asper (Pocock, 1891)
 = *Lychas asper obscurus* Kraepelin, 1913 **syn. n.**
Lychas biharensis Tikader & Bastawade, 1983
Lychas braueri (Kraepelin, 1896)
Lychas buchari sp. n.
Lychas burdoi (Simon, 1882)
 = ? *Lychas burdoi regulosus* Birula, 1916 **syn. n.**
 = *Lychas burdoi rhodesianus* Lawrence, 1938 **syn. n.**
Lychas farkasi sp. n.
 ? *Lychas feae* (Thorell, 1889)
Lychas flavimanus (Thorell, 1888)
Lychas gravelyi Henderson, 1913
Lychas hendersoni (Pocock, 1897)
Lychas heurtaultae sp. n.
Lychas hillyardi sp. n.
Lychas hosei (Pocock, 1891)
 = *Lychas tweediei* Kopstein, 1937 **syn. n.**
Lychas infuscatus (Pocock, 1891)
Lychas kamshetensis Tikader & Bastawade, 1983
Lychas kharpadi Bastawade, 1986
Lychas krati Kovarik, 1995
Lychas laevifrons (Pocock, 1897)
Lychas lourencoi sp. n.
Lychas marmoreus (C. L. Koch, 1844)
 = *Isometrus bituberculatus* Pocock, 1891
 = *Lychas marmoreus obscurus* Kraepelin, 1916
 = *Lychas marmoreus nigrescens* Kraepelin, 1916
 = *Lychas marmoreus splendens* Kraepelin, 1916
 = *Lychas jonesae* Glauert, 1925

Lychas mjobergi Kraepelin, 1916
Lychas mucronatus (Fabricius, 1798)
 = *Scorpio armillatus* Gervais, 1841
 = *Scorpio (Androctonus) curvidigitatus* Gervais, 1843
 = *Tityus varius* C. L. Koch, 1844
 = *Isometrus chinensis* Karsch, 1879
 = *Isometrus atomarius* Simon, 1884
 = *Lychas mentawaius* Roewer, 1943 syn. n.
 = *Lychas baldasseronii* Caporiacco, 1947 syn. n.
 = ? *Lychas nucifer* Basu, 1964 syn. n.
Lychas nigristeris (Pocock, 1899)
 = ? *Lychas decorata* Basu, 1964 syn. n.
Lychas obsti Kraepelin, 1913
Lychas perfidus (Keyserling, 1885)
Lychas rackae sp. n.
Lychas rugosus (Pocock, 1897)
Lychas scaber (Pocock, 1893)
Lychas scutillus C. L. Koch, 1845
 = *Lychas scutatus* C. L. Koch, 1845
 = *Isometrus weberi* Karsch, 1882
 = *Isometrus mesor* Simon, 1884
 = *Isometrus phipsoni* Oates, 1888
 = *Archisometrus nigrimanus* Kraepelin, 1898 syn. n.
Lychas serratus (Pocock, 1891)
Lychas sheffordi (Borelli, 1904)
Lychas shoplandi (Oates, 1888)
Lychas tricarinatus (Simon, 1884)
Lychas variatus (Thorell, 1876)
 = *Isometrus thorelli* Keyserling, 1885
 = *Isometrus variatus papuanus* Thorell, 1888
 = *Isometrus armatus* Pocock, 1891
 = *Lychas marmoreus kimberleyanus* Kraepelin, 1916
 = *Lychas spinatus* Kraepelin, 1916
 = *Lychas spinatus besti* Glauert, 1925
 = *Lychas spinatus pallidus* Glauert, 1925
 = *Lychas lappa* Glauert, 1954

Checklist of species incorrectly placed in the genera *Lychas* C. L. Koch, 1845, and *Archisometrus* Kraepelin, 1891

Lychas maculatus: C. L. Koch, 1845b: 1, fig. 960 = *Isometrus maculatus* (De Geer, 1778: 346) (see Hemprich & Ehrenberg, 1828: pl. 1, fig. 3; Hemprich & Ehrenberg, 1829: 351).
Lychas americanus: C. L. Koch, 1845b: 2, fig. 961 = *Isometrus maculatus* (De Geer, 1778: 346) (syn. by Keyserling, 1885: 6).
Lychas paraensis C. L. Koch, 1845: 6, fig. 963 = *Isometrus maculatus* (De Geer, 1778: 346) (syn. by Thorell, 1888: 406).
Lychas melanodactylus L. Koch, 1867: 239 = *Isometrus melanodactylus* (see Kraepelin, 1891: 248).
Lychas mabilianus Rochebrune, 1884: 28 = ? *Isometrus maculatus* (De Geer, 1778: 346) (syn. by Simon, 1886: 86; Kraepelin, 1899: 96; Lamoral & Reynders, 1975: 511).
Lychas pegleri Purcell, 1902: 173 = *Pseudolychas pegleri* (see Kraepelin, 1911: 59).
Lychas (Hemilychas) alexandrinus Hirst, 1911: 464 = *Hemilychas alexandrinus* see below.
Lychas ochraceus Hirst, 1911: 466 = *Pseudolychas ochraceus* (see Hewitt, 1918: 115).
Lychas emiliae Werner, 1916: 87 = *Uraplectes emiliae* (see Vachon, 1984: 369).
Lychas minshullae Fitzpatrick, 1994: 23 = *Afroisometrus minshullae* (see Kovatík 1997: 35).
Scorpio (Lychas) gabonensis Lucas, 1858: 430 = *Isometrus maculatus* (De Geer, 1778: 346) (syn. by Peters, 1862: 515).
Scorpio (Lychas) guineensis Lucas, 1858: 432 = *Isometrus maculatus* (De Geer, 1778: 346) (syn. by Peters, 1862: 515).
Archisometrus crassimanus Pocock, 1897: 110 = *Hemibuthus crassimanus* (see Pocock, 1900: 34).
Archisometrus basilicus: Kraepelin, 1891: 220 = *Isometrus basilicus* Karsch, 1879a: 113.

DISCUSSION

The first more thorough key of the genus *Archisometrus* (= *Lychas*) was published by Kraepelin (1899: 41–44). It included 20 taxa, of which 16 are still valid *Lychas* species. Kraepelin's key is relatively complex and unnecessarily long, because it omits characters dividing the genus into species groups.

Later Kraepelin (1913: 132–133) published a key containing 10 species from India to Myanmar, in which he used as a primary character the number of granules at the sixth cutting edge on the fingers of pedipalps.

Tikader & Bastawade (1983) published a key comprising 11 species of the genus *Lychas* occurring in India. In an attempt to find characters dividing the species into groups, they used as a primary character the position of trichobothrium db on the tibia of pedipalps relative to the position of trichobothria et and est (Tikader & Bastawade 1983: 41), and divided Indian *Lychas* into three groups defined as subgenera *Distotrichus*, *Alterotrichus*, and *Endotrichus*. The choice of this character was unfortunate, because the position of trichobothrium db exhibits a great deal of intraspecific variation (Vachon 1986: 847, Kovářik 1995: 191, figs 1 and 2), particularly in *L. marmoreus*, *L. mucronatus*, and *L. variatus*. Positions of trichobothria in *Lychas* are therefore useful only as a secondary character aiding in species identification, and not in distinguishing species groups.

The primary characters used in this revision are the number of external granules at the sixth cutting edge (row of granules) on the movable fingers of pedipalps (e. g. Figs 2–20), and the presence of eight or 10 keels on the first, second, and third metasomal segments (*L. kharjadi* has only six keels on the third segment).

The number of external granules at the sixth cutting edge on the movable fingers of pedipalps has so far been used only sporadically for recognizing species (e. g. Kraepelin, 1913: 132–3, Bastawade 1986: 637). My idea to use it for a basic division stems from Kraepelin's (1913) and Vachon's (1986) studies of *Lychas*. This character shows relatively little variation. Some species of *Lychas* do not have any external granules at the sixth cutting edge, and other species have one to five external granules. However, the number of granules is not always the same within a species, e. g. *L. scutillus* has three to five, *L. krati* two or three, and *L. variatus* one to three.

The disadvantage of this character has been the necessity to examine a majority of the species, because the number of external granules is rarely found recorded in the literature. However, Tikader & Bastawade (1983) list it for all the species occurring in India.

The number of external granules is not known for *L. feae* from Myanmar and *L. serratus* from Mauritius. I have not been able to examine these species, for which reason they are not included in the key. Although Kraepelin (1913: 133) noted that *L. feae* does not possess any external granules, it is not clear whether he had a specimen of *L. feae* at his disposal, because to my knowledge this species is not represented in the ZMHB and ZMUH collections.

The number of keels on the second metasomal segment was used already by Thorell (1888: 409), Pocock (1891: 439), Kraepelin (1899: 42) and others, and it is therefore known for all the species. This character appears to be quite stable, I have found it to vary only in *L. burdoi*, *L. marmoreus*, *L. obsti*, *L. shelfordi*, and *L. variatus*.

For further differentiation, in most instances among but a few species, I tried to find easily discernible characters. For this reason the often used number of keels on the ventral surface of the seventh mesosomal segment (e. g. Roewer 1943: 213) does not appear in the key, as these keels are variably developed and often hard to see.

Despite marked size differences among species (21.8–86.5 mm), total length is used only as a secondary character in the key, in order to permit determination of immature specimens as well.

The same applies to sexual dimorphism manifested in twisted or bent fingers of pedipalps (e. g. *L. mucronatus* and *L. kralli*), the length of the metasoma (e. g. *L. scutillus*, *L. shelfordi*), or combination of both (e. g. *L. asper*, *L. nigristeris*, and *L. obsti*). It is interesting that of three examined males of *L. nigristeris* two have the fingers of pedipalps slightly twisted, whereas one does not. However, all males have metasomal segments longer and narrower than females. Some species do not exhibit sexual dimorphism in any of the above characters (e. g. *L. burdoi* and *L. perfidus*).

I have used coloration, chiefly comparing color of the fingers and manus of tibia of pedipalps. It is a convenient and reliable character, although it cannot be applied to some of the old, incorrectly preserved specimens in which the original colors have been lost. Coloration of the tibia of pedipalps nevertheless provides simple means of distinguishing e. g. the Australian species *L. marmoreus* and *L. variatus*, which are highly variable in the number of external granules at the sixth cutting edge on the movable fingers of pedipalps, the number of keels on the first to third metasomal segments, and the numbers of pectinal teeth (in *L. variatus* 12–24 in the males and 10–24 in the females). The complexity of identification of these species is evident from L. E. Koch's (1977: 298) key and from the large number of synonyms and unjustified subspecies. It was precisely the high variability of *L. variatus* and *L. marmoreus* in combination with variability of the African species that led me to divide species of *Lychas* geographically into two keys, because in my opinion two relatively simple keys are preferable to a highly complex single key comprising all the species and necessitating the use of characters such as sexual dimorphism.

Another diagnostic character is the number of pectinal teeth, which in *Lychas* ranges from eight (*L. infuscatus*) to 26 (e. g. *L. buchari* sp. n.). The sparse use of this character in the keys shows that the other characters discussed above divide the genus into groups of more closely related species that share features such as numbers of pectinal teeth.

So far, I have not been able to find any characters that would unequivocally indicate the existence of subgenera within the genus *Lychas*. Early in this study I thought that *L. laevifrons* and *L. tricarinatus* from India might be united in a subgenus because they share three dorsal keels on the mesosoma (whereas other species have only one keel), but this character is present also in *L. braueri* from the Seychelles, which is otherwise very different. These three species are not united by any other characters and certainly do not form a subgenus. Moreover this character is variable in *L. laevifrons* and *L. tricarinatus*.

At present the genus can only be divided into loosely and equivocally defined groups of species, of which most closely related to each other appear to be *L. flavimanus*, *L. hosei*, and *L. scutillus* (*L. scutillus* species-group), or *L. albimanus*, *L. biharensis*, *L. farkasi* sp. n., *L. hendersoni*, *L. heurtaultae* sp. n., *L. kamshetensis*, *L. laevifrons*, *L. shoplandi*, and *L. tricarinatus* (*L. tricarinatus* species-group).

***Hemilychas* Hirst, 1911 stat. n.** (Figs 117–121, Table 1)

Lychas (*Hemilychas*) Hirst, 1911: 464; Birula, 1917a: 105; Glauert, 1925: 111.
Lychas (in part): Kraepelin, 1916: 22; Glauert, 1925: 94; Takashima, 1945: 84; L. E. Koch, 1977: 139; 1981: 877; Vachon, 1986: 845; Sissom, 1990: 102; Locket, 1993: 593; Kovarik, 1995: 189.
Lychas: Locket, 1990: 79.

TYPE SPECIES. *Lychas* (*Hemilychas*) *alexandrinus* Hirst, 1911.

DESCRIPTION. The basic trichobothrial pattern is beta (Fig. 120 and Sissom 1990: 70, fig. 3.3), the third and fourth legs have well developed tibial spurs, pectines bear fulcrs (Sissom 1990: 92, fig.

3.17d), the movable and fixed fingers of pedipalps have six cutting edges (rows of granules) each (Figs 118–119), the entire dorsal surface of the carapace is horizontal in lateral view, the chelicerai fixed finger has a single ventral denticle, and the telson bears a distinct subaculear tooth.

This complex of characters is present in both *Lychas* and *Hemilychas*, but the genus *Hemilychas* is also characterized by one keel on the dorsal surface of the mesosoma, 20–21 pectinal teeth, the position of trichobothria on the tibia and femur of pedipalps (Figs 117 and 120), and most importantly by the shape and texture of the metasomal segments.

The first through third metasomal segments bear 10 keels, the fourth segment bears eight non-granulated blunt keels, and the fifth segment is smooth but punctate (Fig. 121), similarly to the genus *Orthochirus* Karsch, 1891. The fourth segment is punctate and granulate, and the first through third segments are granulate.

The subaculear tooth is pronounced, smooth, with a rounded tip (Fig. 121).

AFFINITIES. Inclusion in the generic key of the family Buthidae in Sissom (1990: 97) is as follows:

- Telson with distinct subaculear tubercle (tooth), ranging in size from small to very large. 1
 1. Fifth metasomal segment without keels and punctate (Fig. 121). *Hemilychas* Hirst **stat. n.**
 – Fifth metasomal segment with keels and smooth or granulated (Fig. 1). *Lychas* C. L. Koch

DISTRIBUTION. Australia (Hirst 1911: 466).

Hemilychas alexandrinus Hirst, 1911

(Figs 117–121, Table 1)

Lychas (*Hemilychas*) *alexandrinus* Hirst, 1911: 464; Birula, 1917a: 105; Glauert, 1925: 111; Main, 1956: 159.

Lychas alexandrinus: Kraepelin, 1916: 23; Takashima, 1945: 84; L. E. Koch, 1977: 139 (in part); 1981: 877 (in part); Vachon, 1986: 845 (in part); Locket, 1990: 79; ? Locket, 1993: 593; Kovarik, 1995: 189 (in part).

? *Lychas truncatus* Glauert, 1925: 85; 1925: 106; Takashima, 1945: 85 (syn. by L. E. Koch, 1977: 139).

? *Lychas annulatus* Glauert, 1925: 107; Takashima, 1945: 85 (syn. by L. E. Koch, 1977: 139).

TYPE LOCALITY. Australia, Alexandria, Northern Territory; BMNH.

TYPE MATERIAL. **Australia:** Alexandria, Northern Territory, IMA (holotype), BMNH No. BM 1907.2.2.1.

DIAGNOSTIC CHARACTERS. As for genus.

COMMENTS. L. E. Koch (1977: 139) regarded *Hemilychas alexandrinus* and *Lychas mjobergi* as one species. Upon examination of the type specimens of both species I am convinced that they represent two distinct species and genera.

However, I am not certain about the taxonomic position of *L. truncatus* and *L. annulatus* described by Glauert in 1925. As I have not been able to examine the types of these species, I follow L. E. Koch (1977: 139), who placed them in synonymy of *H. alexandrinus*.

DISTRIBUTION. Australia (Hirst 1911: 466).

Acknowledgements

I am most grateful to the following individuals and institutions for making this study possible. Paul D. Hillyard (BMNH), Sándor Mahunka and Balázs Farkas (HNHM), Giuliano Doria (MCSN), Jacqueline Heurtault and Wilson R. Lourenço (MNHN), Franco Andreone (MRSN), Sarah Whitman (MZUF), Ambros Hänggi (NHMB), Antonín Kůrka (NMPC), M. Grasshoff and Ulrike Schreiber (SMFD), Martin R. Filmer (TMSA), Manfred Moritz and Shahin Navai (ZMHB), and Hieronymus Dastych (ZMUH) arranged for loans from collections in their care. Matt E. Braunwalder of Zurich, Switzerland, loaned me specimens from his private collection.

Stanislav Bečvář, Svatopluk Bílý, Oldřich Bužga, Petr Dvořák, Jan Farkač, L. Hadaš, Roman Hanzal, Jan Horák, David Král, Vít Kubáň, Karel Petrželka, Jan Schneider, Miroslav Snížek, Jan Strnad, Vladimír Šejna, and Jan Vondráček of the Czech Republic, and Johann Probst of Austria, passed specimens on to me.

Karel Majer drew the habitus of *L. heurtaultae* sp. n. and *L. variatus*, Pavel Krásenský drew all other figures, and Jiří Zidek (New Mexico Tech, Socorro, USA) translated the text.

The National Library of the Czech Republic (International Loans Department) helped with obtaining literature.

REFERENCES

- ARNETT H. R. JR., SAMUELSON G. A. & NISHIDA G. M. 1993: *The insect and spider collections of the world. Flora & Fauna Handbook No. 11, Second edition*. Gainesville: Sandhill Crane Press, 308 pp.
- AUSSERER A. 1880: Arachnida. *Zool. Jahresber. Leipzig* **1879**: 430–470.
- BANKS N. 1928: Scorpiones and Pedipalpi collected by Dr. E. Mjöberg in Borneo. *Sarawak Mus. J.* **3**: 505–506.
- BARTOLOZZI L., VANNI S. & MASCHERINI S. W. 1987: Cataloghi del Museo zoologico "La specola" (sezione del Museo di Storia naturale) dell'Università di Firenze. V. Arachnida Scorpiones: Tipi. *Atti Soc. Tosc. Sci. Natur. Mem., Ser. B* **94**: 293–298.
- BASTAWADE D. B. 1986: New species of scorpion of the genus *Lychas* from Nasik District, Maharashtra, India. *J. Bombay Natur. Hist. Soc.* **83**: 634–637.
- BASU B. D. 1964: Observations on two species of *Lychas*. *J. Bengal Natur. Hist. Soc.* **32**: 99–103.
- BELFIELD W. 1956: A Preliminary Check List of the West African Scorpions and Key for their Identification. *J. West. Afr. Sci. Ass.* **2**: 41–47.
- BIRULA A. A. B. 1915: Miscellanea scorpologica. X. Bemerkungen über die von S. F. Swatosch in Britisch Ost-Afrika gesammelten Skorpionen-Arten. *Ann. Mus. Zool. Acad. St. Petersb.* **19**(1914): 114–124.
- BIRULA A. A. B. 1915: A general list of the Scorpions of British East Africa. *Sci. Res. Zool. Exp. British E. Africa, Uganda* **9**: 1–31.
- BIRULA A. A. B. 1916: Arachnologische Beiträge. V. Weitere Bemerkungen über die Skorpionen-Fauna British Ost-Afrika. *Russk. Entomol. Obozr.* **15**(1915): 50–65.
- BIRULA A. A. B. 1917a: *Fauna Rossii i sopredelnykh stran. Paukoobraznye (Arachnoidea). Tom I. Vypusk 1 (Faune de la Russie et des pays limitrophes (Arachnoidea). Vol. I. Livr. 1*. Petrograd: Zool. Mus. Ross. Akad. Nauk, 224 pp (in Russian, with French title).
- BIRULA A. A. B. 1917b: Chlenistobryukhie paukoobraznye Kavkazskogo Kraja. [Arthropoda: Arachnida of the Caucasus. Part I. Scorpiones]. *Zapiski Kavkaz. Muz., Tbilisi* **5**: 1–253 (in Russian).
- BORELLI A. 1904: Intorno ad alcuni scorpioni di Sarawak (Borneo). *Boll. Mus. Zool. Anat. Comp. Univ. Torino* **19**(477): 1–4.
- BORELLI A. 1919: Missione per la frontiera Italo Etiopica sotto il comando del Capitano Carlo Citermi. Risultati Zoologici. Scorpioni. *Ann. Mus. Civ. Stor. Natur. Genova* **48**: 359–381.
- BORELLI A. 1925: Scorpioni nuovi o poco noti della Somalia Italiana. *Ann. Mus. Civ. Genova* **52**: 9–16.
- BRIGNOLI P. M. 1985: On the correct dates of publication of the arachnid taxa described in some works by C. W. Hahn and C. L. Koch (Arachnida). *Bull. Br. Arachnol. Soc.* **6**: 414–416.
- BUCHERL W. 1959: Escorpiones e Escorpionismo no Brasil. X. Catálogo da coleção escorpionica do instituto Butantan. *Mem. Inst. Butantan* **29**: 255–275.
- CAPORIACCO L. 1937: Su alcuni scorpioni dell'Africa orientale Italiana del civico Museo di Milano. *Atti Soc. Ital. Sci. Natur. Milano* **76**: 355–362.
- CAPORIACCO L. 1941: Arachnida (Esc. Acarina). *Miss. Biol. Sagan-Omo Zool.* **6**: 21–175.
- CAPORIACCO L. 1947: Una nuova specie di *Lychas*. *Acta Pontifica Acad. Scient.* **11**: 247–249.
- CAPORIACCO L. 1949: Aracnidi della Colonia del Kenya raccolti da Toschi e Meneghetti negli anni 1944–46. *Comm. Pont. Acad. Scient.* **13**: 309–492.
- CEKALOVIC T. K. 1982: Estado actual de la colección arachnológica del Museo de zoología de la universidad de concepcion (M. Z. U. C.), parte scorpiones. *Mem. Inst. Butantan* **46**: 187–192.
- DAMMERMAN K. W. 1948: The fauna of Krakatau 1883–1933. *Kon. Ned. Akad. Wet. Verh.* **1948**: 1–594.
- EL-HENNAWY H. K. 1992: A catalogue of the scorpions described from the Arab countries (1758–1990) (Arachnida: Scorpionida). *Serket* **2**: 95–153.
- FABRICIUS J. C. 1793: *Entomologiae Systematica emendata et aucta secundum classes, ordines, genera, species adjectis synonymis, Locis, observationibus, descriptionibus. Tom. II. Hafniae*: impensis Christ. Gottl. Proft., 519 pp.
- FABRICIUS J. C. 1798: *Entomologiae Systematicae. Supplementum. Hafniae*: Apud Proft et Storch, 572 pp.
- FAGE L. 1933: Les scorpions de L'Indochine Française leurs Affinités, leur distribution géographique. *Ann. Soc. Entomol. France* **102**: 25–34.

- FAGE L. 1936: Nouvelle contribution à l'étude des Scorpions de l'Indochine Française. *Bull. Soc. Entomol. France* 41: 179–181.
- FAGE L. 1944: Scorpions et Pédipalpes de l'Indochine Française. *Ann. Soc. Entomol. France* 113: 71–81.
- FARZANPAY R. & VACHON M. 1979: Contribution à l'étude des caractères sexuels secondaires chez les scorpions Buthidae (Arachnida). *Rev. Arachnol.* 2: 137–142.
- FITZPATRICK M. J. 1994: A new species of *Lychas* C. L. Koch, 1845 from Zimbabwe (Scorpionida: Buthidae). *Arnoldia* (Zimbabwe) 10(3): 23–28.
- FRANCKE O. F. 1985: Conspectus genericus Scorpionorum 1758–1982 (Arachnida: Scorpiones). *Occ. Pap. Mus. Texas Tech. Univ.* 98: 1–32.
- DEGEER K. 1778: *Mémoires pour servir à l'histoire des Insectes (tomus 1–7. 1752–1778)*. Stockholm: Pierre Hesselberg, 456 pp.
- GEERAERTS J. 1953: Studie over gift en antgift in verband met de schorpienen van Belgisch-Kongo. *Bull. Agric. Congo Belge* 44(5): 1055–1084.
- GERVAIS M. P. 1841: Arachnides. Pp.: 281–285. In: EYDOUX F. (ed.). *Voyage autour du monde exécuté pendant les années 1836 et 1837 sur la Corvette „La Bonite,” commandée par M. Vaillant*. Paris: A. Bertrand, vol. 1, 290 pp.
- GERVAIS M. P. 1843: Remarques sur la famille des Scorpions et description de plusieurs espèces nouvelles de la collection du Muséum. *Bull. Soc. Philos. Paris* 7: 129–131.
- GERVAIS M. P. 1844: Remarques sur la famille des Scorpions et description de plusieurs espèces nouvelles de la collection du Muséum. *Arch. Mus. Natl. Hist. Natur.* 4: 203–240.
- GERVAIS M. P. 1844: Scorpions. Pp.: 14–74. In: WALCKENAER C. W. & GERVAIS M. P. (eds.): *Histoire naturelle des Insectes*. Paris: Lib. Encyclop. Roret, Tome 3, 418 pp.
- GILTAY M. L. 1931: Scorpions et pédipalpes. Résultats scientifiques du voyage aux Indes Orientales néerlandaises. *Mém. Mus. Royal. Hist. Natur. Belg.* 3(6): 1–28.
- GILTAY M. L. 1935: Liste des arachnides d'extrême-orient et des indes orientales recueillis, en 1932, par S. A. R. le prince Léopold de Belgique. *Bull. Mus. Royal. Hist. Natur. Belg.* 11(20): 1–3.
- GLAUERT L. 1925: Australian Scorpionidea. Part I. *J. Proc. Royal. Soc. West. Austral.* 11(11): 89–118.
- GLAUERT L. 1954: *Lychas lappa* sp. n. A new scorpion from North Queensland. *North Queensland Natur.* 23: 4–5.
- GLAUERT L. 1963: Check list of Western Australian scorpions. *West. Austral. Natur.* 8: 181–185.
- HEMPRICH F. G. & EHRENBURG CH. G. 1828: Animalia articulata. Arachnoidea, Scorpiones africani et asiatici. In: *Symbolae physicae seu icones et descriptiones Animalium evertibratorum sepositis insectis quae ex itinere per Africam Borealem et Asiam Occidentalem*. Berolini: Officina Academica, Decas Prima, Plates IX et X.
- HEMPRICH F. G. & EHRENBURG CH. G. 1829: Vorläufige Uebersicht der in Nord-Afrika und West-Asien einheimischen Scorpione und deren geographischen Verbreitung, nach den eigenen Beobachtungen. *Ges. Natur. Freunde Verh.* 1: 348–362.
- HENDERSON J. R. 1913: Zoological results of the Abor-Expedition 1911. 12. Arachnids. C. Scorpiones. *Rec. Indian Mus.* 8: 128–132.
- HENDERSON J. R. 1919: Two new scorpion from Southern India. *Rec. Indian Mus.* 16: 378–381.
- HERBST J. F. W. 1800: *Naturgeschichte der Skorpionen. Natursystem der Ungeflügelten Insekten*. Berlin: Gottlieb August Lange, 86 pp.
- HEWITT J. 1918: A Survey of the scorpion fauna of South Africa. *Trans. Roy. Soc. S. Africa* 6: 89–192.
- HIRST S. 1911: Descriptions of new Scorpions. *Ann. Mag. Natur. Hist.* 8(8): 462–473.
- HIRST S. 1911: On a Collection of Arachnida and Chilopoda, made by Mr. S. A. Neave in Rhodesia, North of the Zambezi. *Manchester. Mem. Lit. Phil. Soc.* 56: 1–11.
- HIRST S. 1913: Second report on the Arachnida – the scorpions, pedipalpi, and supplementary notes on the opiliones and pseudoscorpions. *Trans. Linn. Soc. Zool. London* 16: 31–33.
- KARSCH F. 1879a: Skorpionologische Beiträge I. and II. *Mit. Münch. Entomol. Ver.* 3: 6–22, 97–136.
- KARSCH F. 1879b: Über einen neuen Skorpion aus der Familie der Androctoniden. *Sitzungsber. Ges. Natur. Freunde Berlin* 8: 119–120.
- KARSCH F. 1882: Ein neuer Skorpion von Salanga. *Berliner Entomol. Ztschr.* 26: 184.
- KARSCH F. 1885: Myriopoden und Arachnoiden. *Jahrb. Hamburg. Wiss. Anst.* 2: 133–138.
- KEYSERLING E. 1885: *Die Arachniden Australiens nach der Natur beschrieben und abgebildet begonnen von Dr L. Koch*. Nürnberg: Verlag von Bauer & Raspe, Part 2, 51 pp.
- KHATOON S. 1986: A Checklist of Arachnids of Pakistan. I. *Bull. Hydrobiol. Res.* 1985–86, 36–37: 645–650.
- KOCH C. L. 1837: *Übersicht des Arachnidensystems. Erstes Heft*. Nürnberg: C. H. Zeh'schen Buchhandlung., 39pp.
- KOCH C. L. 1843: *Die Arachniden* 11(1). Nürnberg: C. H. Zeh'schen Buchhandlung, figs 850–861.
- KOCH C. L. 1844: *Die Arachniden* 11(2). Nürnberg: C. H. Zeh'schen Buchhandlung, figs 862–873.
- KOCH C. L. 1845a: *Die Arachniden* 11. Nürnberg: C. H. Zeh'schen Buchhandlung, 174 pp.
- KOCH C. L. 1845b: *Die Arachniden* 12(1). Nürnberg: C. H. Zeh'schen Buchhandlung, 166 pp, figs 960–968.

- KOCH C. L. 1850: *Übersicht des Arachnidensystems*. 5. Nürnberg: C. H. Zeh'schen Buchhandlung, 104 pp.
- KOCH L. 1867: Beschreibungen neuer Arachniden und Myriapoden. *Verh. Zool.-Bot. Ges. Wien* 17: 173–250.
- KOCH L. E. 1977: The taxonomy, Geographic Distribution and evolutionary radiation of Australo-Papuan Scorpions. *Rec. West. Austral. Mus.* 5: 83–367.
- KOCH L. E. 1980: The primary types of Arachnida, Chilopoda, Diplopoda, Insecta, Onychophora and Pycnogonida in The Western Australia Museum. *Rec. West. Austral. Mus.* 8: 295–326.
- KOCH L. E. 1981: The Scorpions of Australia: Aspects of their ecology and zoogeography. *Ecol. Biog. Austral.* 2: 873–884.
- KOPSTEIN F. 1921: Die Skorpione des Indo-Australischen Archipels. Mit Grundlage der in holländischen Sammlungen, vornämlich des Rijks-Museums in Leiden, vorhandenen Arten. *Zool. Meded. Leiden* 6: 115–144.
- KOPSTEIN F. 1923: Liste der Skorpione des Indo-Australischen Archipels im Museum zu Buitenzorg. *Treubia* 3: 184–187.
- KOPSTEIN F. 1926: De Schorpioenen van Java. *Trop. Natuur* 15: 109–118.
- KOPSTEIN F. 1935: Skorpione von Krakatau und den benachbarten Inseln. *Treubia* 15: 209–210.
- KOPSTEIN F. 1937: A New Scorpion from the Malay Peninsula. *Bull. Raffles Mus.* 13: 175–176.
- KOVAŘÍK F. 1992: A check list of scorpions (Arachnida: Scorpiones) in the collections of the Zoological Department, National Museum in Prague. *Acta Soc. Zool. Bohemoslov.* 56: 181–186.
- KOVAŘÍK F. 1994: *Isometrus zidecki* sp. n. from Malaysia and Indonesia, and a taxonomic position of *Isometrus formosus*, *I. thurstoni* and *I. sankariensis* (Arachnida: Scorpionida: Buthidae). *Acta Soc. Zool. Bohem.* 58: 195–203.
- KOVAŘÍK F. 1995: Review of Scorpionida from Thailand with descriptions of *Thaicharmus mahunkai* gen. et sp. n. and *Lychas krali* sp. n. (Buthidae). *Acta Soc. Zool. Bohem.* 59: 187–207.
- KOVAŘÍK F. 1997: *Afroisometrus* gen. n. from Zimbabwe (Scorpiones: Buthidae). *Acta Soc. Zool. Bohem.* 61: 35–37.
- KOVAŘÍK F. 1997: [Scorpions in captivity from A to Z]. *Akvárium – Terárium* 40(5): 37–40 (in Czech).
- KRAEPELIN K. 1891: Revision der Skorpione. I. Die Familie des Androctonidae. *Jahrb. Hamburg. Wiss. Anstalten* 8(1890): 144–286 (1–144).
- KRAEPELIN K. 1895: Nachtrag zu Theil I der Revision der Skorpione. *Jahrb. Hamburg. Wiss. Anstalten* 12(1894): 73–96.
- KRAEPELIN K. 1896: Neue und wenig bekannte Skorpione. *Jahrb. Hamburg. Wiss. Anst.* 13(1895): 121–145.
- KRAEPELIN K. 1898: Neue Pedipalpen und Skorpione des Hamburger Museums. *Jahrb. Hamburg. Wiss. Anstalten* 15: 39–44.
- KRAEPELIN K. 1898: Die Skorpione Ostafrikas. *Thier. Ost-Afr. Nachber.*, Berlin 4: 1–5.
- KRAEPELIN K. 1899: *Das Tierreich. 8. Lieferung. Scorpiones und Pedipalpi*. Berlin: Verlag von R. Friedländer und Sohn. 265 pp.
- KRAEPELIN K. 1901: Catalogue des Scorpions des collections du Muséum d'Histoire naturelle de Paris. *Bull. Mus. Natl. Hist. Natur. Paris* 7: 265–274.
- KRAEPELIN K. 1905: Zur Nomenklatur der Skorpione und Pedipalpen. *Zool. Anzalten* 28: 195–204.
- KRAEPELIN K. 1905: Die geographische Verbreitung der Scorpione. *Zool. Jb. Syst. Jena* 22: 321–364.
- KRAEPELIN K. 1908: Die sekundären Geschlechtscharaktere der Skorpione, Pedipalpen und Solifugen. *Jahrb. Hamburg. Wiss. Anstalten* 25: 181–225.
- KRAEPELIN K. 1908: Scorpiones. Pp.: 87–104. In: MICHAELSEN W. & HARTMEYER R. (eds): *Die Fauna Südwest-Australiens*. 2(7). Jena: G. Fischer, 212 pp.
- KRAEPELIN K. 1911: Neue Beiträge zur Systematik der Gliederspinnen. *Jahrb. Hamburg. Wiss. Anstalten* 28(1910): 59–107.
- KRAEPELIN K. 1913: Neue Beiträge zur Systematik der Gliederspinnen. III. A. bemerkungen zur Skorpionenfauna Indiens. B. Die Skorpione, Pedipalpen und Solifugen Deutsch-Ostafrikas. *Jahrb. Hamburg. Wiss. Anstalten* 30: 123–196.
- KRAEPELIN K. 1916: Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia 1910–1913. 4. Scolopendriden und Skorpione. *Ark. Zool.* 10: 1–43.
- LAMORAL B. H. & REYNERS S. 1975: A catalogue of the scorpions described from the Ethiopian Faunal Region up to December 1973. *Ann. Natal. Mus.* 22: 489–576.
- LAMPE E. 1918: Katalog der Skorpione, Pedipalpen und Solifugen des Naturhistorischen Museums der Residenzstadt Wiesbaden. *Jahrb. Nassau. Ver. Naturk.* 70: 185–203.
- LATREILLE P. A. 1804: *Histoire naturelle, generale et particulière, des Crustacées et des Insectes. Ouvrage faisant suite aux Oeuvres de Leclerc de Buffon, et partie du Cours complet d'Histoire naturelle rédigé par C. S. Sonnini, membre de plusieurs Sociétés savantes. No. 12*. Paris: F. Dufart, 129 pp.
- LAWRENCE R. F. 1938: The Arachnida of the Transvaal Museum Expedition to South Rhodesia, November–December 1937. Scorpions and Solifugae. *Ann. Transvaal. Mus.* 19: 289–296.
- LAWRENCE R. F. 1955: Solifugae, Scorpions and Pedipalpi, with checklist and keys to South African families, genera and species. Results of the Lund Univ. Exped. in 1950–51. *S. Afr. Anim. Life* 1: 152–262.
- LAWRENCE R. F. 1964: The Solifugae, Scorpions and Pedipalpi of the Kruger National Park. *Koedoe* 7: 30–39.

- LEACH W. E. 1815: A tabular View of the external Characters of Four Classes of Animals, which Linné arranged under Insecta; with the Distribution of the Genera composing Three of these Classes into Orders, etc. and Descriptions of several New Genera and Species. *Trans. Linn. Soc. London* 11: 306–400.
- LOCKET N. A. 1990: New Genus and Species of Scorpion from South Australia (Buthidae: Buthinae). *Trans. R. Soc. S. Austral.* 114: 67–80.
- LOCKET N. A. 1993: Scorpion Distribution a dune and swale mallee environment. *Mem. Queensl. Mus.* 33: 593–598.
- LÖNNBERG E. 1897: On Skorpionernas och Pedipalpernas geografiska utbredning. *Entomol. Tidskr.* 18: 193–211.
- LÖNNBERG E. 1912: Scorpions, Solpugids and Ixodides collected by the Swedish Zoological Expedition to Brit. East-Africa 1911. Scorpions and Solpugids. *Ark. Zool.* 7(24): 1–3.
- LOURENÇO W. R. 1983: Contributions à la connaissance de la faune hypsophile du Malawi (Mission R. Jocqué). 2. Scorpions. *Rev. Zool. Afr.* 97: 192–201.
- LOURENÇO W. R. 1996: *Faune de Madagascar 87. Scorpions (Chelicerata, Scorpiones)*. Paris: S. A. R. L. René Thomas. 102 pp.
- LOVERIDGE A. 1925: Notes on East African Scorpions and Solifugiae, collected 1916–1923. *Proc. Zool. Soc. London* 1925: 303–309.
- LUCAS M. H. 1858: Arachnides. In: THOMSON J. (ed.): Voyage au Gabon. *Arch. Entomol.* 2: 430–432.
- MAIN B. Y. 1956: Taxonomy and biology of the genus *Isometroides* Keyserling (Scorpionida). *Austr. J. Zool.* 4: 158–164.
- MANI M. S. 1959: On a collection of high altitude scorpions and pseudo-scorpion (Arachnida) from the North-West-Himalaya. *Agra Univ. J. Res.* 8: 11–16.
- MATHEW A. P. 1970: Hormonal control of reproduction in a scorpion *Lychas tricarínatus* Simon, 1884. *Bull. Mus. Natl. Hist. Natur. Paris* 41: 123–127.
- MINNOCCI S. P. 1974: Un inventario preliminar de los escorpiones de la region Palearctica y claves para la identificacion de los generos de la region Palearctica occidental. *Fac. Cienc.* 7: 1–45.
- MORITZ M. & FISCHER S.-C. 1980: Die typen der Arachniden-Sammlung des zoologischen museums Berlin. III. Scorpiones. *Mitt. Zool. Mus. Berlin* 56: 309–326.
- MORRIGI M. 1941: Gli Scorpioni dell'Africa orientale Italiana. *Riv. Biol. Col.* 4: 77–103.
- NEWLANDS G. & MARTINDALE C. B. 1980: The Buthid Scorpion Fauna of Zimbabwe-Rhodesia with Checklists and Keys to the Genera and Species, Distributions and Medical Importance (Arachnida: Scorpiones). *Z. Angew. Zool.* 67: 51–77.
- OATES E. W. 1888: On the Indian and Burmese Scorpions of the genus *Isometrus*, with descriptions of three new species. *J. Bombay Soc.* 3: 244–249.
- PAVESI P. 1898: Sugli aracnidi raccolti a Giava dal dott. Ponzig nel 1895–96. *Boll. Sci.* 3: 1–4.
- PETERS W. 1862: Über eine neue Eintheilung der Skorpione und über die von ihm in Mossambique gesammelten Arten von Skorpionen. *Monatsber. Akad. Wiss. Berlin* 1861: 507–520.
- POCOCK R. I. 1891: On some Old-World Species of Scorpions belonging to the Genus *Isometrus*. *J. Linn. Soc. (Zool.)* 23: 432–447.
- POCOCK R. I. 1891: Notes on some Scorpions collected by Mr. J. J. Walker, with Descriptions of Two new Species and a new Genus. *Ann. Mag. Natur. Hist.* 6: 241–247.
- POCOCK R. I. 1893: Notes on the Classification of Scorpions, followed by some Observations upon Synonymy, with Descriptions of new Genera and Species. *Ann. Mag. Natur. Hist.* 6: 303–331.
- POCOCK R. I. 1893: Report upon a small collection of scorpions sent to the British Museum by Mr. Edgar Thurston, of The Government Central Museum, Madras. *J. Bombay Natur. Hist. Soc.* 7(3): 297–312.
- POCOCK R. I. 1894: Scorpions from the Malay Archipelago. Pp.: 84–99. In: WEBER M. (ed.): *Zool. Ergeb. Einer Reise in Niederländisch Ost-Indien*. Leiden: Verlag von E. J. Brill.
- POCOCK R. I. 1894: Scorpions and their Geographical Distribution. *Natur. Sci.* 4(27): 353–364.
- POCOCK R. I. 1897: Descriptions of some new species of scorpions from India. *J. Bombay Soc.* 11: 102–117.
- POCOCK R. I. 1898: On the Arachnida taken in the Transvaal and in Nyasaland by Mr. W. L. Distant And Dr. Percy Rendall. *Ann. Mag. Natur. Hist.* 7: 308–321.
- POCOCK R. I. 1898: The Arachnida from the Regions of Lakes Nyasa and Tanganyika contained in the Collection of the British Museum. *Ann. Mag. Natur. Hist.* 7: 429–448.
- POCOCK R. I. 1898: On the Scorpions, Spiders and Solpugas collected by Mr. C. Steuart Betton in British East Africa. *Proc. Zool. Soc. London* 1898: 497–524.
- POCOCK R. I. 1899: Descriptions of six new species of scorpions from India. *J. Bombay Soc.* 12: 262–268.
- POCOCK R. I. 1899: On the Scorpions, Pedipalps, and Spiders from Tropical West Africa represented in the Collection of the British Museum. *Proc. Zool. Soc. London* 1899: 833–885.
- POCOCK R. I. 1900: *The fauna of British India, including Ceylon and Burma. Arachnida*. London: Taylor and Francis, 279 pp.
- POLIS G. A. 1990: Ecology. Pp.: 248–293. In: POLIS G. A. (ed.): *The biology of Scorpions*. Stanford: Stanford University Press, 587 pp.

- POLIS G. A. & SISSOM W. D. 1990: Life History. Pp.: 161–223. In: POLIS G. A. (ed.): *The biology of Scorpions*. Stanford: Stanford University Press, 587 pp.
- PROBST P. 1972: Zur Fortpflanzungsbiologie und zur Entwicklung der Giftdrüsen beim Skorpion *Isometrus maculatus* (De Geer, 1778) (Scorpiones: Buthidae). *Acta Tropica* **29**: 1–87.
- PROBST P. 1973: A Review of the Scorpions of East Africa with Special Regard to Kenya and Tanzania. *Acta Tropica* **30**: 312–335.
- PURCELL W. F. 1902: On some South African Arachnida belonging to the Orders Scorpiones, Pedipalpi, and Solifugae. *Ann. S. Afr. Mus.* **2**: 137–225.
- ROCHEBRUNE A. T. 1884: Diagnoses d'Arthropodes nouveaux propres à la Sénégambie. *Bull. Soc. Philomathique* **7**: 28–31.
- ROEWER C. F. 1943: Über eine neuerworbene Sammlung von Skorpionen des Natur-Museums Senckenberg. *Senckenberg. Biol.* **26**: 205–244.
- ROEWER C. F. 1952: Solifuga, Opiliones, Pedipalpi and Scorpiones (Arachnoidea). *Explor. Parc. Nat. Upemba Miss. Witte* **5**: 1–36.
- SACHET M. H. 1958: Scorpions on coral Atolls. *Atoll. Res. Bull.* **26**: 1–10.
- SIMON M. E. 1877: Études Arachnologiques. Part IX. Arachnides recueillis aux îles Philippines par MM. G.-A. Baer et Laglaise. *Ann. Soc. Entomol. France* **5**: 93–95.
- SIMON M. E. 1882: Arachnides. Résultats entomologiques du voyage de M. Burds de Zanzibar aux Grands Lacs. *Comptes Rendus Entomol. Belg.* **26**: 58–60.
- SIMON M. E. 1884: Arachnides recueillis en Birmanie par M. le chevalier J. B. Comotto et appartenant au Musée Civique d'Histoire naturelle de Gênes. *Annal. Mus. Civ. Stor. Natur. Genova* **20**: 1–48.
- SIMON M. E. 1886: Sur les Arachnides du Sénégal était à peine paru quand j'ai été informé que M. le Dr A.-T. de Rochebrune, aide-naturaliste à la chaire de Malacologie du Muséum, avait publié en 1883 les descriptions sommaires de deux Arachnides de Sénégambie. *Ann. Soc. Entomol. France* **6**(6): 86.
- SIMON M. E. 1887: Etude sur les Arachnides de l'Asie méridionale faisant partie des collections de l'Indian Museum (Calcutta). I. Arachnides recueillis à Tavoy (Tenasserim) par Moti Ram. *J. Asian. Soc. Beng.* **56**: 101–117.
- SISSOM W. D. 1990: Systematics, Biogeography and Paleontology. Pp.: 64–160. In: POLIS G. A. (ed.): *The biology of Scorpions*. Stanford: Stanford University Press, 587 pp.
- SREENIVASA-REDDY R. P. 1968: Contribution à la connaissance des Scorpions de l'Inde. 5. Le genre *Iomachus* Pocock, 1893 (Scorpionidae, Ischnurinae). *Bull. Mus. Natl. Hist. Natur. Paris* **40**: 759–767.
- STÄHNKE H. L. 1972: A key to the genera of Buthidae (Scorpionida). *Entomol. News* **83**: 121–133.
- STRAND E. 1916: Collectanea Arachnologica. Beiträge zur Bibliographie und Geschichte der Arachnologie. *Arch. Naturg.* **82**: 42–69.
- TAKASHIMA H. 1945: Scorpions of Eastern Asia. *Acta Arachnol.* (Tokyo) **9**: 68–106.
- TAKASHIMA H. 1948: Scorpions of New Guinea. *Acta Arachnol.* (Tokyo) **10**: 72–92.
- TAKASHIMA H. 1950: Notes on the Scorpion of New Guinea. *Acta Arachnol.* (Tokyo) **12**: 17–20.
- THORELL T. 1876: Études scorpiologiques. *Atti Soc. Ital. Sci. Nat.* **19**: 75–272.
- THORELL T. 1888: Pedipalpi e scorpioni dell' Archipelago Malese conservati nel Museo Civico di Storia Naturale di Genova. *Ann. Mus. Civ. Stor. Natur. Giacomo Doria*, **26**: 327–428.
- THORELL T. 1889: Viaggio di Leonardo Fea in Birmanie e regioni vicine. XXI. — Aracnidi Artrogastri Birmani raccolti da L. Fea nel 1885–1887. *Ann. Mus. Genova* **27**: 521–729.
- THORELL T. 1893: Scorpiones exotici R. Musei Historiae Naturalis Florentini. *Bull. Soc. Entomol. Ital.* **25**: 356–387.
- THORELL T. 1894: Företeckning öfver Arachnider från Java och närgränsande öar, insamlade af Docenten Carl Aurivillius; jemte beskrifningar å några sydasiatiska och sydamerikanska spindlar. *Bihang Till K. Svenska Vet.-Akad. Handlingar* **20**(4): 4–63.
- TIKADER B. K. 1987: The Scorpions. Pp.: 20–38. In: *Handbook of Indian Spiders*. (Edited by the Director). Calcutta: Zool. Survey of India, 251 pp.
- TIKADER B. K. & BASTAWADE D. B. 1983: Scorpions (Scorpionida: Arachnida). In: *The Fauna of India, Vol. 3*. (Edited by the Director). Calcutta: Zool. Survey of India, 671 pp.
- VACHON M. 1953: Quelques remarques sur les frontières en biogéographie à propos de la ligne Wallace et des Scorpions Indonésiens. *Comptes Rendus Soc. Biogéogr.* **257**: 6–12.
- VACHON M. 1974: Étude des caractères utilisés pour classer les familles et les genres de Scorpions. *Bull. Mus. Natl. Hist. Natur. Paris* **140**: 857–958.
- VACHON M. 1982: Les scorpions de Sri Lanka (Recherches sur les scorpions appartenant ou déposés au Muséum d'Histoire naturelle de Genève III.). *Rev. Suisse Zool.* **89**: 77–114.
- VACHON M. 1984: Nouvel exemple du rôle important joué en taxonomie par la trichobothriotaxie du bras du pédipalpe chez les scorpions Buthidae (Arachnida): *Lychas emiliae* Werner, 1916 = *Uroplectes emiliae* (Werner, 1916). *Rev. Arachnol.* **5**: 369.

- VACHON M. 1985: Contributions à la révision du genre *Lychas* C. L. Koch, 1845 (Arachnida: Scorpiones: Buthidae). 1. Historique du nom générique. *Rev. Arachnol.* 6: 99–106.
- VACHON M. 1986: Étude de la denture des doigts des pédipalpes chez les Scorpions du genre *Lychas*. *Bull. Mus. Natl. Hist. Natur. Paris* 8: 835–850.
- VACHON M. & ABE T. 1988: Colonization of the Krakatau Islands (Indonesia) by Scorpions. *Acta Arachnol.* (Osaka) 37: 23–33.
- VACHON M. & LOURENÇO W. R. 1985: Scorpions cavernicoles du Sarawak (Borneo). *Chaerilus chapmani* n. sp. (Chaerilidae) et *Lychas hosei* (Pocock, 1890) (Buthidae). *Mém. Biospéol.* 12: 9–18.
- WERNER F. 1916: Über einige Skorpione und Gliederspinnen des Naturhistorischen Museum in Wiesbaden. *Jahrb. Nassauischen Ver. Naturk. Wiesbaden* 69: 79–97.
- WERNER F. 1932: Die Skorpione und Pedipalpen der Deutschen Limnologischen Sunda-Expedition. *Arch. Hydrobiol.* 3: 575–576.
- WERNER F. 1934: Scorpiones. Pp.: 1–316. In: WERNER F. (ed.): *Das Tierreich 5(IV) 8(1935), Scorpiones, Pedipalpi*. Leipzig: Akademische verlagsgesellschaft M. B. H., 490 pp.
- WERNER F. 1936: Neu-Eingänge von Skorpionen im Zoologischen Museum in Hamburg. *Festschrift Prof. Dr. E. Strand, Riga* 2: 171–193.
- WU H. W. 1936: A review of the scorpions and whip-scorpions of China. *Sinensia* 7: 113–127.
- ZIMSEN E. 1964: *The type material of J. C. Fabricius*. Copenhagen: Munksgaard, 639 pp.

Spiders (Chelicerata: Araneae) collected in small mammal nests in the Western Carpathians

František MILLER† & Jan BUCHAR

Department of Zoology, Charles University, Viničná 7, CZ-128 44 Praha 2, Czech Republic

Received January 30, 1997; accepted September 16, 1997
Published December 29, 1997

Abstract. The occurrence of spiders in the nests of six small mammal species (*Tupa europaea*, *Sorex araneus*, *Apodemus flavicollis*, *Clethrionomys glareolus*, *Microtus arvalis* and *Pitymys subterraneus*) was studied in the Moravskoslezské Beskydy Mts., in the drainage area of the Vsetinská Bečva River (Western Carpathians). In 62 out of 251 nests a total of 134 spiders was found, belonging to eight families and 22 species. The relation of these spiders to the nests of the different small mammal species, to the properties of their nests and to the season of occurrence is discussed. The results obtained are compared with literary data from the territory of the Ukraine.

Nests of small mammals, spiders, Czech Republic, Carpathians

INTRODUCTION

After the decease of Professor František Miller (1902–1983), the junior author received from RNDr. Milan Daniel a list of spiders which the senior author, our foremost arachnologist, had determined for him in connection with extensive investigations on parasites and other invertebrates (above all, arthropods) inhabiting nests of small mammals (Mrčiak et al. 1966). The paper just mentioned, on the one hand, characterized the immediate connection of the investigations mentioned above with similar activities of Russian parasitologists under leadership of Academician Pavlovski (Vysockaja et al. 1957) and, on the other, it was the starting point for a number of partial studies that evaluated the occurrence of various taxa. The paper itself evaluated in this way mites of the superfamily Gamasoidea. Fleas (Siphonaptera) from the same material were treated by Ryba et al. (1975), oribatid mites by Bukva et al. (1976), and springtails (Collembola) by Nosek et al. (1978).

The origin and importance of the various components of the fauna inhabiting small mammal nests have been discussed many times (for a review, see, e. g., Bukva 1972). Omitting problems of parasitism, the phenomena involved here are close to synanthropy (the occurrence of spiders in birds' nests on buildings pertains largely to synanthropic species – Svatoň 1985) as well as to the fact that pests of stored agricultural products are probably recruited from inhabitants of such nests (Lindsley 1944).

Although spiders do not form any dominant group in the small mammal nests there are fairly good preconditions for a fairly objective consideration of their occurrence both as regards their distribution under the environmental conditions of central Europe (Buchar 1989, 1992) and in connection with their tendencies towards synanthropic life habits (Valešová-Žďárková 1966).

Abbreviations: F = female, J = juvenile specimen, M = male

METHODS AND MATERIAL

Field work was under way in 1959–1960 in the Moravskoslezské Beskydy Mts., in the drainage area of the Vsetínská Bečva River upstream of the town of Vsetín (ele., 450–740 m) mapping quadrats 6674–75). A total of 251 nests was found during four periods (one in 1959: 28 Nov. – 3 Dec., the rest in 1960: 2–10 Fe., 22–29 Apr., 12–20 July, and 11–15 Dec.).

The nests were collected according to the concept introduced by Prof. S. O. Vysockaja (Vysockaja et al. 1957), who was also present in the first excursion mentioned. Most nests were obtained in places in which the respective small mammals were successfully trapped. In particular, the nests were looked for in old tree stumps or in fallen tree trunks. In a local field station (at Velké Karlovice) the nests were placed in standard funnels with an electric heating plate (Engelbrecht et al. 1965) and the material extracted was deposited in 70 per cent ethylalcohol in 100 ml bottles.

The nests found belonged to three species of insectivores (*Talpa europaea* Linnaeus, 1758; *Sorex araneus* Linnaeus, 1758; and *Sorex minutus* Linnaeus, 1758) and four rodent species (*Apodemus flavicollis* (Melchior, 1834), *Clethrionomys glareolus* (Schreber, 1780), *Microtus arvalis* (Pallas, 1778), and *Pitymys subterraneus* (De Sélys-Longchamps, 1836)). More than ten nests were only found for *C. glareolus* (154), *M. arvalis* (39), *S. araneus* (23) and *A. flavicollis* (22).

The nests contained over 23 thousand arthropods, predominantly mites (Mrciak et al. 1966). According to the paper just cited, spiders participated in this amount by 168 specimens. Nevertheless, the actual number of specimens determined, as follows from Miller's hand-written list, is only 134 (Table 1). The causes of this difference are partly evident already from Miller's own list. Besides the spiders mentioned, the material submitted to Miller for determination also contained 7 harvestmen (*Nemastoma lugubre unimaculatum* Roewer, 1914 1F, *Platybunus bucephalus* (C. L. Koch, 1835) 5J, *Liobunum* sp. 1J). Besides, the material comprised two mites belonging to the family Trombididae.

It was my (J. B.) task to evaluate Miller's list according to the up-date arachnological knowledge. Miller's list contains the following data: number of nest, date, number and taxonomy of spiders found in it. The underlying material has not been preserved. In addition to the list, there was an incomplete card-index containing brief characteristics of fifty (out of the 62) nests in which spiders had been found. Each of the cards shows a serial number of the nest, date of collection, the name of the mammal species, the name of locality, and sometimes also a brief note on its closer location. In addition to that, the cards show a classification of the nests according to the kind of litter (grass, moss, moss plus grass, leaves), situation (on ground surface, below surface, above ground), and habitat type (woodland, clearing, field, meadow).

RESULTS

Taxonomic notes

A total of 134 spider individuals belonging to eight families and 22 species were collected (Table 1). The three most frequently represented families were Linyphiidae (82 exx.), Theridiidae (32 exx.), and Dysderidae (11 exx.). The remaining families were represented by one specimen (3 families) or by three specimens (Amaurobiidae and Clubionidae).

A total of 124 specimens were determined down to species. In the original determination protocol, all immature specimens included under *Lepthyphantes cristatus* were marked with a question mark. Another two immature specimens of the same genus were included under *L. tenebricola* with a query (here they have been listed as *Lepthyphantes* sp. as, contrary to the preceding species, the mammal nests contained no adult specimen).

The immature specimens accounted for 76.8% of the total amount (adults being found of only half of the species ascertained) but, thanks to the determining person's great experience, their correct identification and taxonomic classification can be taken for granted in the absolute majority of cases.

A specific problem is posed by three specimens (2F, 1J) originally determined as *Lepthyphantes monticola*. On the basis of revision (Thaler & Buchar 1993), the high mountain species *L. monticola* should be replaced, at these lower altitudes, by the montane species *L. tripartitus*, which was described by Miller and Svatoň only 20 years later (Miller & Svatoň 1978). Nevertheless, already in the 1960s, determining a male of *L. monticola* from the Šumava Mts., Miller expressed some doubts as to its specific identity with his specimens from the Tatra Mts. (the terra typica of *L. monticola*).

Table 1. List of species found

Dysderidae: <i>Harpactea lepida</i> (C. L. KOCH, 1838) 1M, 10J.
Linyphiidae: <i>Asthenargus paganus</i> (SIMON, 1884) 1F, <i>Ceratinella brevis</i> (WIDER, 1834) 2J, <i>Lepthyphantes cristatus</i> (MENGE, 1866) 1M, 2F, 21J, <i>Lepth. leprosus</i> (OHLERT, 1865) 1J, <i>Lepth. pallidus</i> (O. P.-CAMBRIDGE, 1871) 1M 3J, <i>Lepth. tripartitus</i> MILLER & SVATOŇ, 1978 2F, 1J, <i>Lepth. sp.</i> 2J, <i>Macrargus rufus</i> (WIDER, 1834) 1J, <i>Muso sundevalli</i> (WESTRING, 1851) 2J, <i>Microneta viaria</i> (BLACKWALL, 1841) 4J, <i>Neriene radiata</i> (WALCKENAER, 1841) 1J, <i>Pityohyphantes phrygianus</i> (C. L. KOCH, 1836) 2J, <i>Tapinocyba affinis</i> (LESSERT, 1907) 2M, 7F, 9J, <i>Thyreosthenius parasiticus</i> (WESTRING, 1851) 5F, 5J, (+ 7 undetermined specimens).
Theridiidae: <i>Robertus lividus</i> (BLACKWALL, 1836) 5F, 27J.
Hahniidae: <i>Cryphoea silvicola</i> (C. L. KOCH, 1834) 1F.
Cybaeidae: <i>Cybaeus angustiarum</i> L. KOCH, 1868 1J.
Amurobiidae: <i>Callobius claustrarius</i> (HAHN, 1833) 2J, <i>Coelotes inermis</i> (L. KOCH, 1855) 1F.
Dictynidae: <i>Cicurina cicur</i> (FABRICIUS, 1793) 1J.
Clubionidae: <i>Clubiona diversa</i> O. P.-CAMBRIDGE, 1862 1F, <i>Clubiona subsultans</i> THORELL, 1875 1J, <i>Clubiona sp.</i> 1J.

Relation of the spiders under study to small mammal nests

The fauna under study was collected in 251 nests. Spiders were not represented in most of them. They occurred in 62 nests only (24.7%). While 35 spiders were found singly in one nest each, almost a half of them (66 spiders) came from only 12 nests in which 4–9 spiders were found together.

Unfortunately, complete documentation is not available for all nests that contained spiders but for only fifty nests. These fifty nests belonged to six mammal species (only the two nests of *Sorex minutus* lacked spiders at all). The largest number of nests inhabited by spiders was found in *C. glareolus* (35 out of 154) and in *Sorex araneus* (8 out of 23), less so in *Apodemus flavicollis* (3 out of 22), *Microtus arvalis* (two of 39), *Talpa europaea* (one out of six) and *Pitymys subterraneus* (one out of five).

Almost a half of the spiders came from 12 nests. Most of the nests (but for one) were collected outside the growing season. They belonged solely to three species (*C. glareolus*, *Sorex araneus* and *Apodemus flavicollis*) and never to *Microtus arvalis*.

As regards the classification of nests according to the kind of litter, leaves were the most frequent (26 cases, out of them 24 of *C. glareolus*), followed by moss (8 cases, out of them 7 of *C. glareolus*). Grass was the litter material in 9 cases (3 times *S. araneus*, twice *M. arvalis* and 1 case of each of the four remaining species), moss plus grass in 7 cases (3 times *C. glareolus* and *S. araneus*, once *A. flavicollis*).

As regards the situation of the nests, they were most frequently found underground (32, out of them 25 of *C. glareolus*), 9 times on the ground and 9 times above ground.

As regards the habitat type, most nests came from woodland (38; of these, 30 *C. glareolus*, 5 *S. araneus* and 3 *A. flavicollis*), nine from clearings (5 *C. glareolus*, 3 *S. araneus*) and only 3 from a meadow (*M. arvalis*, *T. europaea*).

One may assume that the character of those nests which harboured more than 3 spiders may indicate properties that are particularly suitable for the presence of spiders. But for one case (a nest of *C. glareolus* in a tree stump near a stream, littered with moss, collected on 17 July 1960), the remaining 7 nests came from the period between 29 Nov. and 10 Feb. and between 11 and 15 Dec. Complete documentation is available for these six nests only. All of them came from woodland habitat and all were situated in a tree stumps or (in one case) beneath wood in a high mature forest. Their litter material is rather diverse but it never consisted solely of grass. Only the nest of *S. araneus* found in a virgin forest reserve Ostružná contained an admixture of grass to its moss litter. These nineteen spiders (among others, 8 exx. of *Robertus lividus*, 5 exx. of

Table 2. Distribution of spiders according to families over successive sampling seasons

Families	A	B	Period C	D	E
Dysderidae (11)	1	—	7	1	2
Linyphiidae (82)	27	4	18	8	25
Theridiidae (32)	7	5	1	13	6
Hahniidae	—	1	—	—	—
Cybaeidae	1	—	—	—	—
Amurobiidae	—	—	2	1	—
Dictynidae	—	—	—	1	—
Clubionidae	—	—	2	—	1
Total (134)	36	10	30	24	34

Lepth. cristatus, and 5 exx. of *Tapinocyba affinis*) were found in three nests of *C. glareolus*, eight (6 spp.) in two nests of *S. araneus*, and five (2 times *Harpactea lepida* and *Rob. lividus*, once *Lepth. cristatus*) in a single nest of *A. flavicollis*.

Phenological aspects of the occurrence of the spiders under study

The absolute majority of spiders belonged to three families: Linyphiidae (82), Theridiidae (32) and Dysderidae (11). Their representatives were rather uniformly distributed over all seasons. The absence of Dysderidae from the February sample was most probably connected with the fact that the least number of spiders at all was collected in that period (Table 2).

In general, the occurrence of adult spiders (Table 3) showed a pattern contrary to that reported for central European conditions, concerning the division of the period of sexual activity (spring peak, Tretzel 1954: Abb. 19). In our case, this may be due to the fact that no material was available from the most frequented months (May to June) but mainly because two thirds of the adults belonged to three species: *Tapinocyba affinis* (9 specimens), *Thyreosthenius parasiticus* (5 exx.), and *Robertus lividus* (5 exx.), whose sexual activity is observed all the year round (Tretzel 1954).

Ecological notes on the occurrence of some spider species

Tapinocyba affinis: invariably in woodland environments, nests in tree stumps in 4 cases, in one case the nest of *C. glareolus* was found above ground, the rest were equally below and on the ground, littered with all three types of litter material including grass (two cases) used by *S. araneus*.

Thyreosthenius parasiticus: invariably in woodland environments, in nests situated in tree stumps (above ground in one case, on the ground in one case), litter material: leaves (4 times *C. glareolus*), also moss or moss plus grass (*S. araneus*).

Robertus lividus: mostly woodland environments (9 out of 11), built of leaves in six cases, all types of construction in the rest.

Lepthyphantes tripartitus: both nests of *C. glareolus*, each containing a female of this species, came from the woodland environment. One was found in the locality Dynčák in a tree stump near a stream, the other one beneath wood in a high mature forest. Both nests were found below ground. The first one was constructed of moss, the other one was littered with leaves.

Asthenargus paganus: one female found in a woodland habitat in a nest of *C. glareolus* situated in a rotten tree stump. It was constructed of moss and grass on the ground.

Clubiona diversa: a female of this species was found (apparently hibernating) in a meadow in an underground nest of *Talpa europaea* littered with grass.

DISCUSSION

Evaluation of the species spectrum ascertained

To this end one can utilize the classifications that have arisen from the results of analyses of long-term investigations on the spider fauna of Bohemia (Buchar 1992).

Classified by their abundance, most species (16) were abundant, four were medium abundant (*Tapinocyba affinis*, *Thyreosthenius parasiticus*, *Cryphoea silvicola*, *Cybaeus angustiarum*) and two were rare (*Asthenargus paganus* and *Lepthyphantes tripartitus*).

Fourteen species belonged to the psychrophilous component. First of all, this group comprised all rare and medium abundant species mentioned above, which, in contrast to the abundant ones, show greater tendency towards narrowing their ecological valence. None of the species belonged to thermophilous ones.

As to requirements for habitat integrity, the two rare species belong to the category of first order relicts, as they are tied exclusively with habitats least influenced by man. Only three species (*Lepthyphantes leprosus*, *Thyreosthenius parasiticus* and *Cicurina cicur*) show high tolerance of habitats heavily disturbed by man's activities, the remaining ones showing medium anthropotolerance.

All species (except *Robertus lividus*) belonged to the category of woodland species or those equally abundant in and outside woodland. The absolute majority of species are epigeic, an exception being provided by two web-building species inhabiting the herb layer (*Neriene radiata* and *Pityohyphantes phrygianus*) and two species regularly collected both on the ground and in higher herb layers (*Thyreosthenius parasiticus* and *Clubiona subsultans*).

Causes of the occurrence of spiders in vertebrate nests

In only a small number of spider species ascertained there is an unequivocal explanation for their presence in mammal nests. These include, above all, web-building species which may utilize the nests as hibernacula (*Neriene radiata* and *Pityohyphantes phrygianus*) and probably also both *Clubiona* spp.

A special position is occupied by *Lepthyphantes leprosus*, denoted as hemisynantropic (Valešová-Ždárková 1966, as well as Sacher, 1983), and also *Thyreosthenius parasiticus*. In the paper by Valešová-Ždárková (1966) this species is reported as merely xenanthropic. However,

Table 3. Distribution of adult spiders over successive seasons. A = autumn 1959 (28 Nov.–3 Dec.), B = February 1960 (2–10 Feb.), C = April 1960 (22–29 Apr.), D = July 1960 (12–20 July), E = December 1960 (11–15 Dec.)

Species	A	B	Period C	D	E
<i>Harpactea lepida</i>	–	–	–	1	–
<i>Asthenargus paganus</i>	–	–	1	–	–
<i>Lepthyphantes cristatus</i>	–	–	–	–	3
<i>Lepthyphantes pallidus</i>	1	–	–	–	–
<i>Lepthyphantes tripartitus</i>	–	–	–	1	1
<i>Tapinocyba affinis</i>	5	1	2	1	–
<i>Thyreosthenius parasiticus</i>	4	–	–	1	–
<i>Robertus lividus</i>	–	–	1	3	1
<i>Cryphoea silvicola</i>	–	1	–	–	–
<i>Coelotes inermis</i>	–	–	–	1	–
<i>Clubiona diversa</i>	–	–	–	–	1
Total (30)	10	2	4	8	6

numerous data are available indicating its rather close relationship to human habitations (Buchar, unpublished data on the occurrence of this species in cellars). Tretzel (1952) reports the occurrence of 15 specimens in a heap of compost in a built-up urban area. Besides, the species has been reported inhabiting chinks beneath the bark of trees (Buchar 1981) and, at the same time, characterized as myrmecophilous (Maurer & Hänggi 1990). It is worthwhile to note its fairly frequent occurrence in corridors of sandstone rock towns (Buchar 1989, Růžicka & Kopecký 1994).

The remaining species are mostly common or rarer inhabitants of forest litter and thus they have enough preconditions for invading small mammal nests. One may assume that the occurrence of spiders in vertebrate nests is quite accidental and there are no species that would be adapted to such environments both trophically (as they are mostly non-specialized predators) or otherwise, as they inhabit diverse types of birds' and mammal nests, from underground ones to those occurring in tree crowns (Vysockaja 1977, Křištofik et al. 1993).

Zoogeographic aspects of the composition of arachnocoenosis found in small mammal nests Comparing our observations with those of Russian and Ukrainian researchers (Vysockaja 1967, 1974, 1978, Sklyar & Popov 1972), it becomes apparent that the number of spider families and species represented in small mammal nests increases with every additional paper published. As regards families (so far 18 have been ascertained), Linyphiidae predominate markedly, followed by less frequent Theridiidae. In nests found on the shores of the Sea of Azov (Sklyar & Popov 1972), moreover, even such rather exotic spider families as Scytodidae and Zodariidae were represented. Only the occurrence of a single species (*Thyreosthenius parasiticus*) was repeatedly ascertained in three different samplings (in addition to our own one, also in the papers by Vysockaja 1967, 1974).

CONCLUSIONS

Spiders were inhabited about 25% of nests of small mammals. Almost a half of them came from twelve nests (4–9 spiders per nest) built in old tree stumps or under fallen trees.

Species from the families Linyphiidae, Theridiidae and Dysderidae are the most abundant. Members of these families were uniformly represented in all sampling dates, built in old tree stum

Most of the spider species belonged to woodland epigeic fauna. The three most abundant species (*Tapinocyba affinis*, *Thyreosthenius parasiticus* and *Robertus lividus*) accounted for over a half of the adults recorded (18 out of 30).

Comparing our results with those of foreign authors, one may expect that studies of additional samples may result in an increase in both of the total number of species and families. Only *Thyreosthenius parasiticus* was common to three out of five materials compared. This species shows high tolerance of habitats heavily disturbed by man's activities and the predisposition to accidental synanthropy.

Acknowledgements

I wish to express my thanks (J. B.) to Dr M. Daniel, DrSc. for providing data having basic importance for this work and to Dr Ing. R. Obrtel for the translation of my manuscript.

REFERENCES

- BUCHAR J. 1981: [Die Spinnen der Třeboň-Umgebung aus der Sammlung von Gymnasial-Professor J. Martínek]. *Sbor. Jihočes. Muz. v Čes. Budějovicích, Přír. Vědy* 21: 1–12.
- BUCHAR J. 1989: [The knowledge of the present Bohemian arachnofauna and its improvement to evaluation of natural conditions]. Dissertation. Faculty of Sciences, Charles University, Praha. 171 pp. (in Czech).
- BUCHAR J. 1992: Kommentierte Artenliste der Spinnen Böhmens (Araneida). *Acta Univ. Carol. – Biol.* 36: 383–428.
- BUKVA V. 1972: [Invertebrate fauna in the nests of small mammals. Review prepared for the examination]. Unpubl., Faculty of Sciences, Charles University, Praha. Pp. 72 (in Czech).
- BUKVA V., DANIEL M. & MRČIAK M. 1976: Oribatid mites (Acari, Oribatei) in the nests of small mammals in the Western Carpathians. *Věst. Čs. Společ. Zool.* 40: 241–254.
- ENGELBRECHT H., JIROVEC O., NEMESÉRY L. & ROSICKÝ B. 1965: *Parasitologische Arbeitsmethoden in Medizin und Veterinärmedizin*. Berlin: Akademie-Verlag, 259 pp.
- KRISTOFÍK J., MAŠAN P., ŠUSTEK Z. & GAJDOŠ P. 1993: Arthropods in the nests of penduline tit (*Remiz pendulinus*). *Biológia (Bratislava)* 48: 493–505.
- LINDSLEY E. G. 1944: Natural sources, habitats and reservoirs of insects associated with stored food products. *Hilgardia* 16: 187–224.
- MAURER R. & HÄNGGI A. 1990: Katalog der schweizerischen Spinnen. *Doc. Faun. Helvet. Mus. Natur. Neuchatel.* 12: 1–412.
- MILLER F. & SVATON J. 1978: Einige seltene und bisher unbekannte Spinnenarten aus der Slowakei. *Annot. Zool. Bot. Bratislava* 126: 1–19.
- MRČIAK M., DANIEL M. & ROSICKÝ B. 1966: Parasites and nest inhabitants of small mammals in the western Carpathians. 1. Mites of the superfamily Gamasoidea (Parasitiformes). *Acta Fac. Rer. Natur. Univ. Comen. – Zool.* 13: 81–116.
- NOSEK J., DANIEL M. & MRČIAK J. 1978: Apterygota in nests of small mammals in the Western Carpathians. *Věst. Čs. Společ. Zool.* 42: 43–51.
- RČIČKA V. & KOPECKÝ J. 1994: Spiders of pseudokarst caves in northeastern Bohemia. *Boll. Acc. Gioenia Sci. Nat. Catania* 26(345)[1993]: 299–309.
- RYBA J., ROSICKÝ B., DANIEL M. & MRČIAK M. 1975: Siphonaptera of small terrestrial mammals and their nests in the Western Carpathians. *Folia Parasit. (Praha)* 22: 45–56.
- SACHER P. 1983: Spinnen (Araneae) an und in Gebäuden – Versuch einer Analyse der synanthropen Spinnenfauna in der DDR. *Ent. Nachr. Ber.* 27: 97–104, 141–152, 197–204, 224.
- SKLYAR V. E. & POPOV E. V. 1972: Spiders (Aranei) from burrows of rodents in the Azov territory near Donetsk. *Zool. Zh.* 51: 602–604.
- SVATON J. 1985: Die Spinnen (Araneida) aus den Nestern der Mehlschwalbe, *Delichon urbica* (L.) in der Westslowakei. *Zbor. Slov. Nár. Múz. Přír. Vedy Bratislava* 31: 189–192 (in Slovak, Germ. summ).
- THALER K. & BUCHAR J. 1993: Eine verkannte Art der Gattung *Lepthyphantes* in Zentraluropa: *L. tripartitus* MILLER & SVATON (Araneida: Linyphiidae). *Mitt. Schweiz. Entomol. Ges.* 66: 149–158.
- TRETZEL E. 1952: Zur Ökologie der Spinnen (Araneae). Autökologie der Arten im Raum von Erlangen. *Sber. Phys. – Med. Soc. Erlangen* 75: 36–131.
- TRETZEL E. 1954: Reife und Fortpflanzungszeit bei Spinnen. *Ztschr. Morph. Ökol. Tiere* 42: 634–691.
- VALEŠOVÁ-ŽDÁRKOVÁ E. 1966: Synantropie Spinnen in der Tschechoslowakei. *Senckenberg. Biol.* 47: 73–75.
- VYSOCKAJA S. O. 1967: [Biocenotic relationships between ectoparasites of rodents and inhabitants of their nests]. *Parazitol. Sb. Zool. Inst. AN SSSR* 23: 19–60 (in Russian).
- VYSOCKAJA S. O. 1974: [Biocenotic relationships between ectoparasites of the common red-backed vole *Clethrionomys glareolus* SCHREB., and inhabitants of its nests in the Transcarpathian region of the Ukraine]. *Parazitol. Sb. Zool. Inst. AN SSSR* 26: 114–143 (in Russian).
- VYSOCKAJA S. O. 1977: [Microbiocenoses of the nests of transcarpathian squirrel (*Sciurus vulgaris carpathicus* P.)]. *Parazitol. Sb. Zool. Inst. AN SSSR* 27: 181–191 (in Russian).
- VYSOCKAJA S. O. 1978: [Analysis of biocenotic interrelations between ectoparasites and nest-inhabitants of common vole (*Microtus arvalis* PALL.) in the East-Carpathians]. *Parazitol. Sb. Zool. Inst. AN SSSR* 18: 73–85 (in Russian).
- VYSOCKAJA S. O. & BREGETOVA N. G. 1957: [Gamasid mites, the parasites of field voles and mice and inhabitants of their nests in the Leningrad region]. *Parazitol. Sb. Zool. Inst. AN SSSR* 17: 5–37 (in Russian).

Succession of epigeic spider communities (Araneae) on spoil banks in North Bohemia

Vlastimil RŮŽIČKA¹⁾ & Jiří HEJKAL²⁾

¹⁾Institute of Entomology, Czech Academy of Sciences, Branišovská 31, CZ–370 05 České Budějovice, Czech Republic

²⁾Wolkerova 711/48, CZ–358 01 Kraslice, Czech Republic

Received May 15, 1996; accepted January 30, 1997

Published December 29, 1997

Abstract. Spider communities on large-area spoil banks constituted of grey Miocene clay in North Bohemian mining district were studied. The age of the study plots was 0.5, 2, 6, 17 and 22 years old. The 1st stage was free from any vegetation, the 2nd and 3rd stages had sporadic annual plants, the 4th and 5th stages had perennial plants, mostly of the graminaceous species. Spoil banks were soon occupied by pioneering spiders of the families Linyphiidae and Lycosidae. The most significant species in the first two years of succession are *Oedothorax apicatus* (Blackwall, 1850), *Porrhomma microphthalmum* (O. P.-Cambridge, 1871), *Pardosa agrestis* (Westring, 1862) and *Trochosa ruricola* (Degeer, 1778). Later, those species were replaced by *Diplostyla concolor* (Wider, 1834), *Aulonia albimana* (Walckenaer, 1805), *Alopecosa accentuata* (Latreille, 1817), *Alopecosa pulverulenta* (Clerck, 1757). The community diversity reached its maximum in the 17th-year stage. Scarcely but not irregularly, some rare species also appeared on the spoil banks during the succession, benefiting from the temporarily low competition in the non-equilibrium community and forming rather numerous ephemeral populations. In this manner, the species *Mioxena blanda* (Simon, 1884) and *Zelotes aeneus* (Simon, 1878) were observed on the North-Bohemian spoil banks.

Succession, diversity, dispersal, spoil banks, spiders, Czech Republic

INTRODUCTION

Numerous studies have been devoted to the secondary succession of spider communities. Merrett (1976) studied spiders on burnt heathlands. Huhta (1971) studied succession in the spider communities of the forest floor after clearcutting and prescribed burning. Schaefer (1980) studied succession of arthropods in burned pine forests. Fewer opportunities exist to investigate the primary succession of communities of invertebrates. Heydemann (1960, 1961) examined the succession of spider communities on polders of the Northern Sea shore. Majkus (1988) studied spider communities on pit heaps of various ages in the Ostrava mining district (North Moravia). Crawford (1995) studied spider arrival and primary establishment on terrain depopulated by volcanic eruption at Mount St. Helens, Washington.

The present study is concerned with spider communities occupying large unreclaimed areas of spoil banks of various ages which represent the by-products of open-pit mining in the North-Bohemian brown coal mining district. Succession of communities of carabid beetles in this territory were studied by Hejkal (1985).

STUDY AREA AND LOCALITIES

Spoil banks of the North Bohemian brown coal mining district are located in the central part of the Most basin, between the towns of Litvínov and Most, N.W. Bohemia (average coordinates 50°35' N, 13°35' E). Their altitudes range from 240 to 280 m a. s. l., average annual temperatures 7–8 °C, average annual precipitation 550–650 mm. The spoil banks originate from a translocation of the overlying strata of open-pits which at first are absolutely sterile. Their main components are grey Miocene clays.

Young spoil banks with a sparse plant cover are typical of extreme microclimatic conditions, evidencing themselves in considerable overheating of the surface and a notable daily fluctuation of temperature values. Extreme conditions occur particularly in sites exposed to the south-west. A maximal temperature value for the spoil bank surface (64 °C) was obtained from a slack bank exposed to the south. A dense grass stand at a distance of 1 m reduced the temperature by about one half (Štýs & Výborová 1966). The first plant communities appear on spoil banks usually in the second year of formation, and consist predominantly of ruderal plants. According to Toběrná (1973), the initial succession community is the association *Atriplicetum nitensis* Knapp., after about 5-6 years this is generally replaced gradually by the association *Tanacetum-Artemisietum* Br.-Bl. Older spoil banks are colonized by communities of perennial grasses, most frequently those of the association *Arrhenatheretum elatioris* Bl.-Br. The influence of trees, except *Sambucus nigra*, on the leaf cover and the composition of the herbaceous layer is still negligible on unreclaimed spoil banks (Bejček 1983).

Spider communities of five plots on three spoil banks were studied (Table 1). All these study plots had several features in common: macroclimate, large size, grey Miocene clays, elevation (from 15 to 25 m), none had been reclaimed at the time of the investigation, and none was in contact with waterlogged sites. Basic differences among the individual stages were in the plant cover. It was absent in stage S₁, generally less than 50% in stage S₂ and S₃, and attained 100% in stage S₄ and S₅. Of considerable importance was the fact that annual plants were dominant in S₂ and S₃, while S₄ and S₅ were colonized mainly by perennial plants (Prach 1982). This fact was reflected by the dynamics of the plant cover in the course of the year: while the plant cover was more or less constant on older spoil banks, it increased from the spring months onwards to a maximum at the end of summer and in autumn on younger spoil banks. Greatly dependent on the level of plant cover were the properties of the microclimate which again influenced notably the incidence of the individual animal species.

Stage S₁. Růžodol spoil bank lies about 1 km south of Litvinov. It was surrounded mainly by fallows, grasslands and fields. It was started in spring 1966 and has been continuously enlarged, in 1980 covered about 600 ha. Study plot S1 was about one month old and completely bare.

Stage S₂. Růžodol spoil bank. This study plot was about one year old. The vegetation cover ranged from 0.5 to 6%. The vegetation cover consisted mainly of *Atriplex nitens*, *Senecio viscosus*, *Matricaria maritima* ssp. *inodora*, *Tussilago farfara*, *Epilobium angustifolium*, *Tanacetum vulgare* and *Rumex acetosella* appearing in 1979. Annual plants were dominant.

Stage S₃. Růžodol spoil bank. The age of this study plot was four years. Generally, 10-50% of the area was covered by vegetation, but some sites were still completely bare. The most frequent plants were *Senecio viscosus*, *Cirsium arvense*, *Atriplex nitens*, *Tussilago farfara*, *Matricaria maritima* ssp. *inodora*, *Carduus* sp., *Sinapis urvensis*, *Arctium lappa* and *Agropyron repens*. The proportion of annual (biennial) and perennial plants were more or less balanced, but annual plants were still dominant. *Sambucus nigra* was present on several sites.

Stage S₄. Horní Jiřetín spoil bank lies about 1.5 km SW of Litvinov. It was started in 1954, and spoil dumping was continued until 1965. It was surrounded mainly by fields and fallows and was about 450 ha. The study plot was 17 years old. Mostly, the vegetation cover attained 100%. Perennial plants such as the graminaceous species *Calamagrostis epigeios*, *Agropyron repens* and *Deschampsia caespitosa* were dominant. Dicotyls were represented mainly by *Carduus* sp., *Cirsium arvense*, *Epilobium angustifolium*, *Tussilago farfara*, *Echinops sphaerocephalus* and *Potentilla* sp. *Sambucus nigra* was present, attaining a height of several metres.

Stage S₅. Albrechtice spoil bank, about 5 km SW of Litvinov. It originated in 1954, and dumping was discontinued in 1961. In its surroundings were mainly fields and an open-pit. The bank covered an area of about 170 ha. The study plot was about 20 years old. The vegetation cover was practically 100%, and dominated already by graminaceous species, mainly *Calamagrostis epigeios*, *Agrostis* sp., *Poa trivialis*, *Festuca rubra* and *Deschampsia caespitosa*. Dominant among the perennial dicotyls were *Cirsium arvense*, *Tussilago farfara* and *Tanacetum vulgare*. *Sambucus nigra* was common and *Betula pendula* occasional, both species attaining a height of several metres. *Acer pseudoplatanus* and *Fraxinus excelsior* were rare in the locality, their height was 1-2 m.

METHODS

Material was collected by pitfall traps filled with 4% formaldehyde, in 1980 (from May to October). On each site, 20 traps were placed in a straight line at intervals of 20 m. An exception was the locality Albrechtice (Stage 5), 40 traps were laid on this locality. Each trap was covered with a concave piece of tarred cardboard secured to the ground with 10 cm nails.

For assessment of the spider communities under study, the index of total diversity H' was used: $H' = -\sum D_i \cdot \log_2 D_i$, where D_i = dominance of the i -th species.

Two similarity indices for a comparison of succession stages were used:

Sørensen's quotient of similarity $QS = 2c/(a + b)$, where a = number of species in sample A, b = number of species in sample B, c = number of species common both to A and B.

Renkonen's coefficient of percentage similarity $PS = \sum \min(D1, D2)$. Index is calculated after a logarithmic transformation of data ($\ln [x + 1]$).

On the basis of cephalothorax length, spider species are classified into four size classes: 1st class to 1.30 mm, 2nd class from 1.31 to 2.00 mm, 3rd class from 2.01 to 3.20, 4th class above 3.20 mm (Růžička 1985).

Table 1. Survey of localities studied

Succession stage	Spoil bank	Age (years)	Vegetation cover (%)	Dominant plant species
S ₁	Růžodol	0.5	0	–
S ₂	Růžodol	2	0.5–6	Annual
S ₃	Růžodol	6	10–50	Annual
S ₄	Horní Jiřetín	17	90–100	Perennial
S ₅	Albrechtice	22	100	Perennial

The material was evaluated with respect to the occurrence of the species in habitats of various degree of originality (Buchar 1992): I – species occurring prevalingly in natural habitats corresponding to climatic or edaphic climax, II – species capable of occupying some shadow and wet secondary, semi-natural habitats (cultural forests, shrubs, cultivated wetlands), III – species capable of forming viable populations in artificially deforested, man-made habitats (fields, meadows, depenies).

RESULTS

2097 determineable spiders representing 80 species were collected (Table 2). 13 families were taken on spoil banks studied. The most important were Linyphiidae, Lycosidae, Gnaphosidae (all more than 100 specimens), Salticidae, Theridiidae and Liocranidae (20–60 specimens).

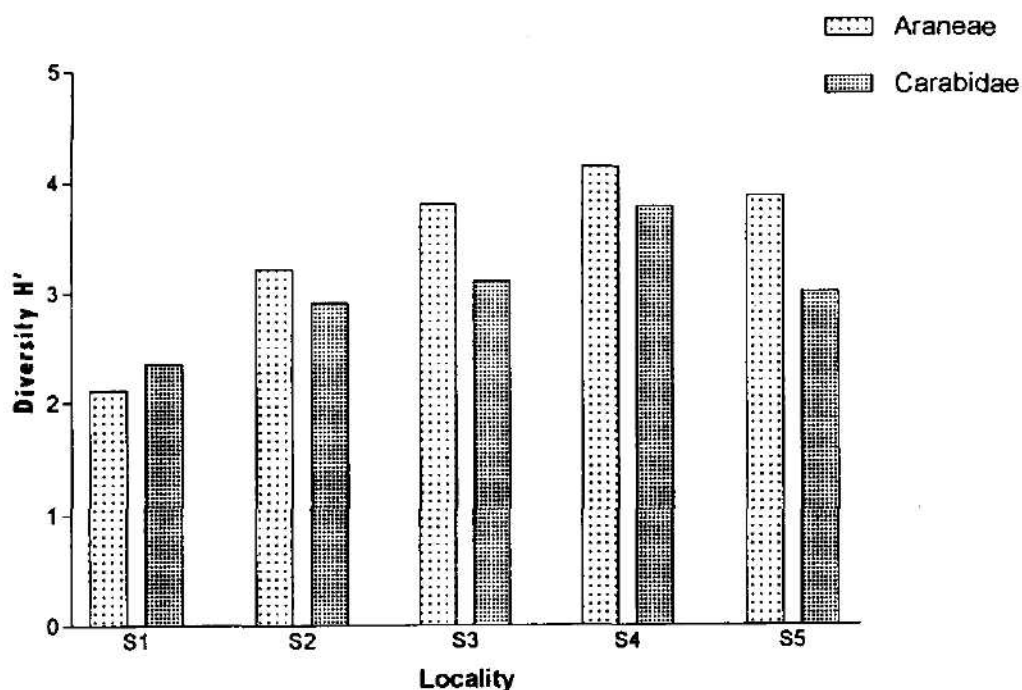


Fig. 1. Total diversity (H') of epigeic spider and carabid communities of various successional stages on spoil banks studied.

Table 2. Survey of material. Family: 1. Theridiidae, 2. Linyphiidae, 3. Tetragnathidae, 4. Lycosidae, 5. Agelenidae, 6. Dictynidae, 7. Liocranidae, 8. Clubionidae, 9. Gnaphosidae, 10. Zoridae, 11. Philodromidae, 12. Thomisidae, 13. Salticidae. Degree of originality: I. species of natural habitats, II. species of semi-natural habitats, III. species of man-made habitats. Spiders are divided into four size classes, number of specimens is given

Fam.	Orig.	Species	Stadium				
			S ₁	S ₂	S ₃	S ₄	S ₅
1st size class							
2	III	<i>Oedothorax apicatus</i> (Blackwall, 1850)	235	15	—	—	—
2	III	<i>Meioneta rurestris</i> (C. L. Koch, 1836)	25	11	5	—	—
2	III	<i>Ostearius melanopygius</i> (O. P. Cambridge, 1879)	11	8	1	—	—
2	II	<i>Bathypantes gracilis</i> (Blackwall, 1841)	7	1	—	—	—
2	III	<i>Oedothorax retusus</i> (Westring, 1851)	1	—	—	—	—
2	II	<i>Tiso vagans</i> (Blackwall, 1834)	1	—	—	—	—
2	II	<i>Lepthyphantes tenuis</i> (Blackwall, 1852)	1	1	—	—	—
2	II	<i>Walckenaeria unicornis</i> O. P.-Cambridge, 1861	4	—	—	1	—
2	III	<i>Porrhomma microphthalmum</i> (O. P.-Cambridge, 1871)	4	108	70	—	1
2	III	<i>Erigone atra</i> Blackwall, 1833	1	7	—	1	—
2	III	<i>Diplocephalus cristatus</i> (Blackwall, 1833)	1	—	1	—	—
2	III	<i>Meioneta saxatilis</i> (Blackwall, 1844)	—	1	—	—	—
2	III	<i>Erigone dentipalpis</i> (Wider, 1834)	—	1	2	—	—
2	III	<i>Dicymbium nigrum</i> (Blackwall, 1834)	—	—	1	—	—
2	II	<i>Walckenaeria antica</i> (Wider, 1834)	1	—	1	1	1
2	I	<i>Mioxena blanda</i> (Simon, 1884)	—	3	4	2	2
2	II	<i>Walckenaeria capito</i> (Westring, 1861)	—	—	—	2	—
2	I	<i>Meioneta beata</i> (O. P.-Cambridge, 1906)	—	—	—	1	—
2	III	<i>Micrargus herbigradus</i> (Blackwall, 1854)	1	5	6	7	9
2	III	<i>Micrargus subaequalis</i> (Westring, 1851)	1	5	1	1	11
2	III	<i>Bathypantes parvulus</i> (Westring, 1851)	1	3	2	11	19
2	III	<i>Lepthyphantes mengei</i> Kulczynski, 1887	1	—	—	12	12
2	III	<i>Diplostyla concolor</i> (Wider, 1834)	1	2	2	33	124
7	II	<i>Phrurolithus festivus</i> (C. L. Koch, 1835)	—	—	9	3	34
1	I	<i>Euryopis flavomaculata</i> (C. L. Koch, 1836)	—	—	—	23	4
2	II	<i>Lepthyphantes tenebricola</i> (Wider, 1834)	—	—	—	—	1
2	II	<i>Walckenaeria atrotibialis</i> (O. P.-Cambridge, 1878)	—	—	—	—	1
2	I	<i>Walckenaeria corniculans</i> (O. P.-Cambridge, 1875)	—	—	—	—	1
2	II	<i>Lepthyphantes pallidus</i> (O. P.-Cambridge, 1871)	—	—	—	—	4
2	III	<i>Pocadicnemis pumila</i> (Blackwall, 1841)	—	—	—	—	7
2nd size class							
2	I	<i>Sintula corniger</i> (Blackwall, 1856)	1	—	—	—	—
3	III	<i>Pachygnatha degeeri</i> Sundevall, 1830	2	4	1	—	—
2	III	<i>Centromerita bicolor</i> (Blackwall, 1833)	1	1	—	2	—
1	II	<i>Robertus lividus</i> (Blackwall, 1836)	—	1	1	—	—
1	III	<i>Robertus arundineti</i> (O. P.-Cambridge, 1871)	—	18	21	—	1
6	III	<i>Dictyna arundinacea</i> (Linné, 1758)	—	—	1	—	—
1	III	<i>Enoplognatha thoracica</i> (Hahn, 1833)	—	—	2	—	—
13	II	<i>Euophrys petrensis</i> C. L. Koch, 1837	—	—	21	1	—
2	III	<i>Centromerus sylvaticus</i> (Blackwall, 1841)	—	2	—	8	4
9	III	<i>Drassyllus pusillus</i> (C. L. Koch, 1833)	—	—	14	13	11
13	II	<i>Euophrys frontalis</i> (Walckenaer, 1802)	—	1	1	14	20
2	II	<i>Neriene clathrata</i> (Sundevall, 1830)	—	—	—	1	—
9	I	<i>Zelotes electus</i> (C. L. Koch, 1839)	—	—	—	1	13
2	II	<i>Tallusia experta</i> (O. P.-Cambridge, 1871)	—	—	—	—	2
3rd size class							
4	III	<i>Pardosa agrestis</i> (Westring, 1862)	30	1	—	—	—
11	III	<i>Tibellus oblongus</i> (Walckenaer, 1802)	1	—	—	—	—

4	II	<i>Xerolycosa nemoralis</i> (Westring, 1861)	1	2	—	—	—
4	II	<i>Pardosa lugubris</i> (Walckenaer, 1802)	1	—	1	—	—
3	III	<i>Pachygnatha clercki</i> Sundevall, 1823	—	2	—	—	—
1	III	<i>Enoplognatha ovata</i> (Clerck, 1757)	—	1	—	—	—
12	III	<i>Xysticus kochi</i> Thorell, 1872	2	1	9	1	—
4	II	<i>Xerolycosa miniata</i> (C. L. Koch, 1834)	—	3	3	—	—
10	II	<i>Zora spinimana</i> (Sundevall, 1833)	2	—	—	—	2
9	I	<i>Haplodrassus dalmatensis</i> (L. Koch, 1866)	—	—	9	—	—
8	III	<i>Clubiona lutescens</i> Westring, 1851	—	—	1	—	—
4	III	<i>Pardosa palustris</i> (Linné, 1758)	—	—	1	—	—
12	III	<i>Xysticus cristatus</i> (Clerck, 1757)	—	—	1	2	—
9	I	<i>Zelotes aeneus</i> (Simon, 1878)	—	—	1	1	—
4	III	<i>Pardosa pullata</i> (Clerck, 1757)	—	—	—	14	—
2	III	<i>Linyphia triangularis</i> (Clerck, 1757)	—	—	—	4	—
4	III	<i>Pardosa prativaga</i> (L. Koch, 1870)	—	—	—	2	—
8	II	<i>Clubiona neglecta</i> O. P.-Cambridge, 1862	—	—	—	1	—
3	III	<i>Metellina segmentata</i> (Clerck, 1757)	—	—	—	1	—
4	II	<i>Aulonia albimana</i> (Walckenaer, 1805)	—	—	3	23	16
9	I	<i>Drassyllus praeficus</i> (L. Koch, 1866)	—	—	1	—	3
9	II	<i>Zelotes latreillei</i> (Simon, 1878)	—	—	—	19	12
2	III	<i>Stemonyphantes lineatus</i> (Linné, 1758)	—	—	—	1	1
9	III	<i>Haplodrassus signifer</i> (C. L. Koch, 1839)	—	2	2	6	9
9	II	<i>Zelotes petrensis</i> (C. L. Koch, 1839)	—	—	—	—	47
13	II	<i>Phlegra fasciata</i> (Hahn, 1826)	—	—	—	—	1
4th size class							
4	III	<i>Trochosa ruficollis</i> (Degeer, 1778)	13	38	29	9	12
5	II	<i>Tegenaria agrestis</i> (Walckenaer, 1802)	—	2	—	—	—
9	II	<i>Drassodes lapidosus</i> (Walckenaer, 1802)	1	2	17	1	—
4	II	<i>Alopecosa accentuata</i> (Latreille, 1817)	—	1	68	32	5
9	II	<i>Drassodes pubescens</i> Thorell, 1856	—	—	3	8	5
4	III	<i>Trochosa terricola</i> Thorell, 1856	1	—	2	1	25
4	III	<i>Alopecosa pulverulenta</i> (Clerck, 1757)	—	—	1	73	116
4	III	<i>Alopecosa cuneata</i> (Clerck, 1757)	—	—	—	1	52

The diversity of spider communities clearly increase from the initial succession stage to the 17-year stage, after which the parameter decrease slightly (Fig. 1). The changes in the similarity indices document the diminishing similarity between the initial succession stage and the other stages during the succession process. The two indices employed indicate a similar succession rate. The similarity between the most recent and the oldest stages is 18% (PS) or 31% (QS) (Table 3).

Oedothorax apicatus is the dominant species in the first year of development in size class 1. Other abundant species include *Meioneta rurestris*, *Ostearius melanopygius*, and *Bathypantes gracilis*. The frequency of these pioneering species in the community, however, decreases rapidly. *Porrhomma microphthalmum* is the dominant species in the 2-year and 6-year stages, *Diplostyla concolor* and *Euryopis flavomaculata* are the dominant species in the 17-year stage, and *Diplostyla concolor* and *Phrurolithus festivus* are the dominant species in the 22-year stage.

Size class 2 is least abundant. *Robertus arundineti* is reasonably abundant in the 2nd and 6th years of development, the species *Euophrys petrensis* and *Drassyllus pusillus* appear in the 6th year, to be gradually superseded by the species *Euophrys frontalis* and *Zelotes electus*, respectively.

In size class 3, *Pardosa agrestis* is the dominant species in the first year but vanishes soon. The species *Xysticus kochi* and *Haplodrassus dalmatensis* were observed most abundant in the

Table 3. Sørensen's (QS) and Renkonen's (PS) quotient of similarity. Communities of olders successional stages compared with the youngest stage S_1

	QS	PS
S_2	0.60	0.50
S_3	0.45	0.33
S_4	0.38	0.20
S_5	0.32	0.18

6th year. Rather abundant are species in this size class only in the 17th and 22nd year of succession: these are *Aulonia albimana*, *Zelotes latreillei*, *Pardosa pullata* and *Zelotes petrensis*.

In size class 4, *Trochosa ruricola* is rather abundant in all succession stages and is most abundant in the first two stages, to be superseded by *Alopecosa accentuata* as the most abundant species in the 3rd stage, which in turn is superseded by *Alopecosa pulverulenta* and *Alopecosa cuneata* in the 4th and 5th stages.

Species of artificial habitats predominate vastly (94%) in the first two years of succession. The first colonizers, *Oedothorax apicatus* and *Pardosa agrestis*, have been found as pioneer colonists on barren habitats created in natural conditions by stream flooding or clearcut logging. Their tendency to massive ballooning is thus easily explained as a strategy for colonizing new or ephemeral habitats. In the 3rd, 4th and 5th stages, the proportion of such species decreases to 55, 60, and 70%, respectively, and this group is represented by the species *Trochosa ruricola*, *Alopecosa pulverulenta*, *Alopecosa cuneata* and *Diplostyla concolor*.

The proportion of species of semi-natural habitats is mere 5–6% in the first two succession stages, to increase to 40, 32, and 26% in the 3rd, 4th, and 5th stages, respectively. *Alopecosa accentuata*, *Drassodes lapidosus*, *Euophrys petrensis*, *Aulonia albimana*, *Zelotes petrensis* and *Phrurolithus festivus* are the most abundant species of this group.

Species of natural habitats are least abundant. In total, the following 9 species were recorded: *Mioxena blanda*, *Haplodrassus dalmatensis*, *Euryopis flavomaculata*, *Zelotes electus*, *Drassylus praeficus*, *Zelotes aeneus*, *Meioneta beata*, *Walckenaeria corniculans* and *Sintula corniger*.

DISCUSSION

Aerial fallout was the primary source of living organisms and dead organic matter on bare terrains, spoil banks in the first year of succession included. The first colonizers must be able to reach the new territory, and to survive under mostly extreme microclimatic conditions. Another predatory animals, windblown herbivores, and detritophages (eating windblown organic matter) can serve as food sources for spiders. It was estimated e. g. for stony debris ecosystems in high mountains (Edwards 1987, Růžicka & Zacharda 1994).

The high activity of spiders found as early as the 1st succession stage is a general observation if the material is trapped in pitfall traps (Heydemann 1960, 1961, Meijer 1973). This is due to the fast propagation of spiders by ballooning on their silks on the one hand, and by the good permeability of the bare environment and the high locomotive activity of spiders on the other hand.

The development of the species diversity of spider communities during the spoil bank succession resembles that of carabid beetles (Hejkal 1985) (Fig. 1).

Spiders are among the most numerous terrestrial predators and are believed to capture high fraction of herbivorous insects; therefore, they are considered major contributors to biocontrol of agricultural pests (Wise 1993). Rapid dispersal, a prerequisite for colonization of frequently

disturbed agricultural land, is accomplished by spiders through ballooning, which is prevalent for example in Linyphiidae and Lycosidae. The three most important species in the first year of succession on spoil banks, *Oedothorax apicatus*, *Meioneta rurestris* and *Pardosa agrestis*, are well known as agrobionts (Miller 1974, Luczak 1979). The occurrence of *Ostearius melanopygius* was recorded in the first years of succession; this excellent balooner has been imported to Europe and over the past decades it has been progressing through Europe eastwards (Růžicka 1995).

The rare species *Zelotes aeneus* and *Mioxena blanda* have also been observed by Majkus (1982) on spoil banks in the Ostrava bituminous coal mining district. The bare surfaces of fresh spoil banks in central Europe constitute a habitat resembling a semi-arid environment of rock steppes or sandy habitats and temporarily enable development of populations of some thermophilous species inhabiting natural ecosystems of this kind. Tawny Pipit (*Anthus campestris*) and Wheatear (*Oenanthe oenanthe*), two bird species preferring natural sandy and stony habitats with sporadic plant cover, nest on fresh spoil banks (Bejček & Tyrner 1980).

CONCLUSIONS

The large areas of spoil banks, the hundreds of hectares of overburden hidden before under the ground, constitute in the landscape a new, sterile habitat, which is soon colonized by spiders and other invertebrates. As early as the first year, the spoil banks are colonized by opportune, aeronautic species, particularly ones of the families Linyphiidae and Lycosidae.

In the subsequent stages of development, as the initially bare surface is grown up, the pioneering spider species are superseded by species of gramineous communities. The species richness of the spider community attains its maximum roughly in the 15th to 20th year of development.

By their microclimate, the bare surfaces of the fresh spoil banks resemble rock steppes or sandy habitats, later, grass steppes. This offers an opportunity for some succession stages to be regularly occupied by some rare species as well. Such species take advantage of the favourable microclimatic conditions in combination with the low competition in the non-equilibrium community to form rather abundant ephemeral populations.

Acknowledgement

The authors are indebted to Prof. Jan Buchar for determination of the spider material and valuable comments on the manuscript.

REFERENCES

- BEJČEK V. 1983: Succession and productivity of small mammals on spoil banks of the Most basin. *Studie ČSAV* 24: 1–70 (in Czech, Engl. abstr.).
- BEJČEK V. & TYRNER P. 1980: Primary succession and species diversity of avian communities on spoil banks after surface mining of lignite in the Most basin (north-western Bohemia). *Fol. Zool.* 29: 67–77.
- BUCHAR J. 1992: Kommentierte Artenliste der Spinnen Böhmens. *Acta Univ. Carol. – Biol.* 36: 383–428.
- CRAWFORD R. L. 1995: Spider arrival and primary establishment on terrain depopulated by volcanic eruption at Mount St. Helens, Washington. *Amer. Midl. Natur.* 133: 60–75.
- EDWARDS J. S. 1987: Arthropods of alpine acolian ecosystems. *Ann. Rev. Entomol.* 32: 163–179.
- HEJČAL J. 1985: The development of a carabid fauna (Coleoptera, Carabidae) on spoil banks under conditions of primary succession. *Acta Entomol. Bohemoslov.* 82: 321–346.
- HEYDEMANN B. 1960: Verlauf und Abhängigkeit von Spinnensukzessionen im Neuland der Nordseeküste. *Verh. D. Zool. Ges. Bonn* 54: 431–457.

- HEYDEMANN B. 1961: Die biozönotische Entwicklung vom Vorland zum Koog. Vergleichend-ökologische Untersuchungen an der Nordseeküste. I. Teil: Spinnen (Araneae). *Abh. Math.-Naturw. Kl.* **1960**: 747–913.
- HUHTA V. 1971: Succession in the spider communities of the forest floor after clear-cutting and prescribed burning. *Ann. Zool. Fenn.* **8**: 483–542.
- LUCZAK J. 1979: Spiders in agrocoenoses. *Pol. Ecol. Stud.* **5**(1): 151–200.
- MAJKUS Z. 1982: Beitrag zur Bionomie der Art *Zelotes aeneus* (Simon, 1878). *Acta Fac. Paed. Ostraviensis, Series E-12* **79**: 35–45.
- MAJKUS Z. 1988: Ökologisch-faunistische Charakteristik von Arachnozönosen ausgewählter Ostrava-Bergbalden. *Spisy Pedagog. Fak. v Ostravě* **63**: 1–190 (in Czech, Germ. abstr.).
- MEDER J. 1973: Die Besiedlung des neuen Lauwerszeepolders durch Laufkäfer (Carabidae) und Spinnen (Araneae). *Faun.-Ökol. Mitt.* **4**: 169–184.
- MERRETT P. 1976: Changes in the ground-living spider fauna after heathland fires in Dorset. *Bull. Brit. Arachnol. Soc.* **3**: 214–221.
- MILLER F. 1974: Spider fauna of sugar beet fields in the surroundings of Chválkovice and Náklo in Haná. *Acta Univ. Palack. Olom., Fac. Rer. Natur., 47, Biol.* **15**: 175–181.
- PRACH K. 1982: Vegetation of substrates originating from mineral working. *Acta Ecol. Natur. Reg., Praha* **1982**: 49–50 (in Czech, Engl. abstr.).
- RŮŽIČKA V. 1985: The size groups in the spiders (Araneae) and carabids (Col. Carabidae). *Acta Univ. Carol. – Biol.* **1982–1984**: 77–101.
- RŮŽIČKA V. 1995: The spreading of *Ostearius melanopygius* through Europe. *Eur. J. Entomol.* **92**: 723–726.
- RŮŽIČKA V. & ZACHARDA M. 1994: Arthropods of stony debris in the Krkonoše Mountains, Czech Republic. *Arctic Alpine Res.* **26**: 332–338.
- SCHAEFER M. 1980: Sukzession von Arthropoden in verbrannten Kiefernforsten II. Spinnen (Araneida) und Weberknechte (Opilionida). *Forstwiss. Centralbl.* **90**: 341–356.
- ŠTÝS S. & VÝBOROVÁ A. 1966: [Vegetation of spoil banks in the N. Bohemian brown coal area]. *Ochr. Přír., Praha* **21**: 133–136 (in Czech).
- TOBĚRNA V. 1973: [Phytocoenological characteristics of selected plant communities on several spoil banks of the Most basin]. Unpubl. PhD-thesis, Faculty of Pedagogy. Praha: Charles University (in Czech).
- WISE D. H. 1993: *Spiders in ecological webs*. Cambridge: Cambridge University Press, 328 pp.

A new species of Linyphiidae (Araneae) from the sudeto-carpathian range (Czech Republic and Slovakia)

Konrad THALER¹⁾, Jan BUCHAR²⁾ & Antonín KŮRKA³⁾

¹⁾ Institute of Zoology and Limnology, University of Innsbruck, Technikerstraße 25, A–6020 Innsbruck, Austria

²⁾ Department of Zoology, Charles University, Viničná 7, CZ–128 44 Praha 2, Czech Republic

³⁾ Department of Zoology, National Museum, Václavské nám. 68, CZ–115 79 Praha 1, Czech Republic

Received August 18, 1996; accepted September 16, 1997

Published December 29, 1997

Abstract. *Meioneta milleri* sp. n. is described from Giant Mts. and Jizerské Mts. (Czech Republic) and from the High Tatra (Slovakia). It differs from its nearest relative *M. ressi* Wunderlich, 1973 from the Alps in the shape of lamella characteristica. Both can probably be combined together with the boreal transpalearctic *M. similis* (Kulczynski, 1926) as a superspecies. Hence speciation may have occurred as a result of range fragmentation of a stem species and isolation of relict populations in European mountains in the mesocratic phase of a glacial cycle.

Taxonomy, superspecies, Linyphiidae, *Meioneta milleri* sp. n., sudeto-carpathian range

INTRODUCTION

When working on the spider communities of bogs of the Krkonoše Mts. (Giant Mts.), J. B. soon recognised the presence of enigmatic specimens of *Meioneta* Hull, 1920 close to the common aeronautic species *M. rurestris* (C. L. Koch, 1836). Following a discussion with the late Prof. F. Miller of Brno, they were regarded as a variety of this latter species and therefore do not stand separately in the species list (Buchar 1967). The taxonomy of *Meioneta* in mid-Europe has since been discussed by Wunderlich (1973). Recently A. K. collected new material of this enigmatic undescribed *Meioneta* in the Jizerské Mts. near to the original sites and another population was discovered in the Vysoké Tatry Mts. (High Tatra Mts.) (leg. J. Rusek). They strongly resemble a further enigmatic „subspecies“ discussed by Miller (1947), *M. r. ovata* (C. L. Koch, 1841), which was also accepted by Platnick (1993). We therefore decided to reinvestigate this taxonomic problem.

Abbreviations: MHNG Muséum d'Histoire naturelle, Genève; NMP National Museum, Prague; NMW Naturhistorisches Museum, Wien; SNMB Slovak National Museum, Bratislava. Tm metatarsal trichobothrium. All measurements are in mm.

IDENTIFICATION

As can be seen from the description below, this enigmatic *Meioneta* sp. stands clearly as a separate taxon, closely allied to *M. rurestris* and to *M. ressi*. The best diagnostic characters are provided by the lamella characteristica (figs 9, 10). Other details of the male palpal organ are almost identical. To our surprise, the lamella is identical to that of *M. r. ovata* as described by Miller (1947). Miller mentions 3 males of *M. r. ovata*, which he regarded as extreme variants and probably for this reason did not indicate localities. The specimens could not be traced in Miller's collection at the National Museum, Prague (Kůrka 1994, 1996). On his original drawing which is kept by J. B., however a locality name is added: Kriváň. This is a main summit in

the High Tatra close to the place where Rusek's specimens came from. We therefore feel sure about the identity of Miller's „subspecies“.

This „subspecies“ is definitely different from *Micryphantes ovatus* C. L. Koch, 1833. This is an erigonine species, as can be seen from Koch (1841: tab. 279). Figs 665, 666 show both sexes without leg spines and the male (fig. 665) with a strong tibial apophysis projecting beyond the cymbium, whereas *M. rurestris* is figured without tibial apophysis and with long spines on patellae and tibiae (Koch, 1836: tab. 101, figs 231, 232). *M. ovatus* was correctly recognised as erigonine by Dahl (1883, 1886), but nevertheless mis-interpreted as *Tapinocyba insecta* (L. Koch, 1869). In our opinion, *M. ovatus* stands as *species inquirenda*. On the contrary Reimoser (1919) and Roewer (1928) continued to include *M. ovatus* in *Micryphantes*, together with species later transferred to *Meioneta* Hull, 1920. Miller (1947) probably accepted the name *ovatus* from Roewer's key (1928). We therefore propose *M. milleri* sp. n. as replacement name for *M. rurestris ovata* in the sense of Miller (1947).

DESCRIPTION

Meioneta milleri sp. n.

(figs 1–4, 7, 9–10)

M. rurestris ovatus (C. L. Koch, 1833) – Miller (1947: 73, tab. 9, Fig. 12); Platnick (1993: 318).

MATERIAL EXAMINED. Czech Republic: Giant Mts. (Krkonoše, Riesengebirge), Pančická louka [5259] ca 1300 m a. s. l., in peat bogs, 8 males 1962/63 (Buchar 1967, sub *M. rurestris*). Jizerské Mts. (Isergebirge), Rašeliniště Jizery peat bog [5158], 830 m a. s. l., 1 male, 31 May 1994, leg. Kůrka. Slovakia: High Tatra, Roháčce, Polská Tomanová [6785], ca 1950 m a. s. l., in pitfalls (7 July 1992 – 22 June 1993) 10 males leg. Rusek. Depository: 1 male Holotype (type locality Pančická louka) NMP, Paratypes MHNG (2 males), NMP (4 males), NMW (2 males), SNMB (2 males).

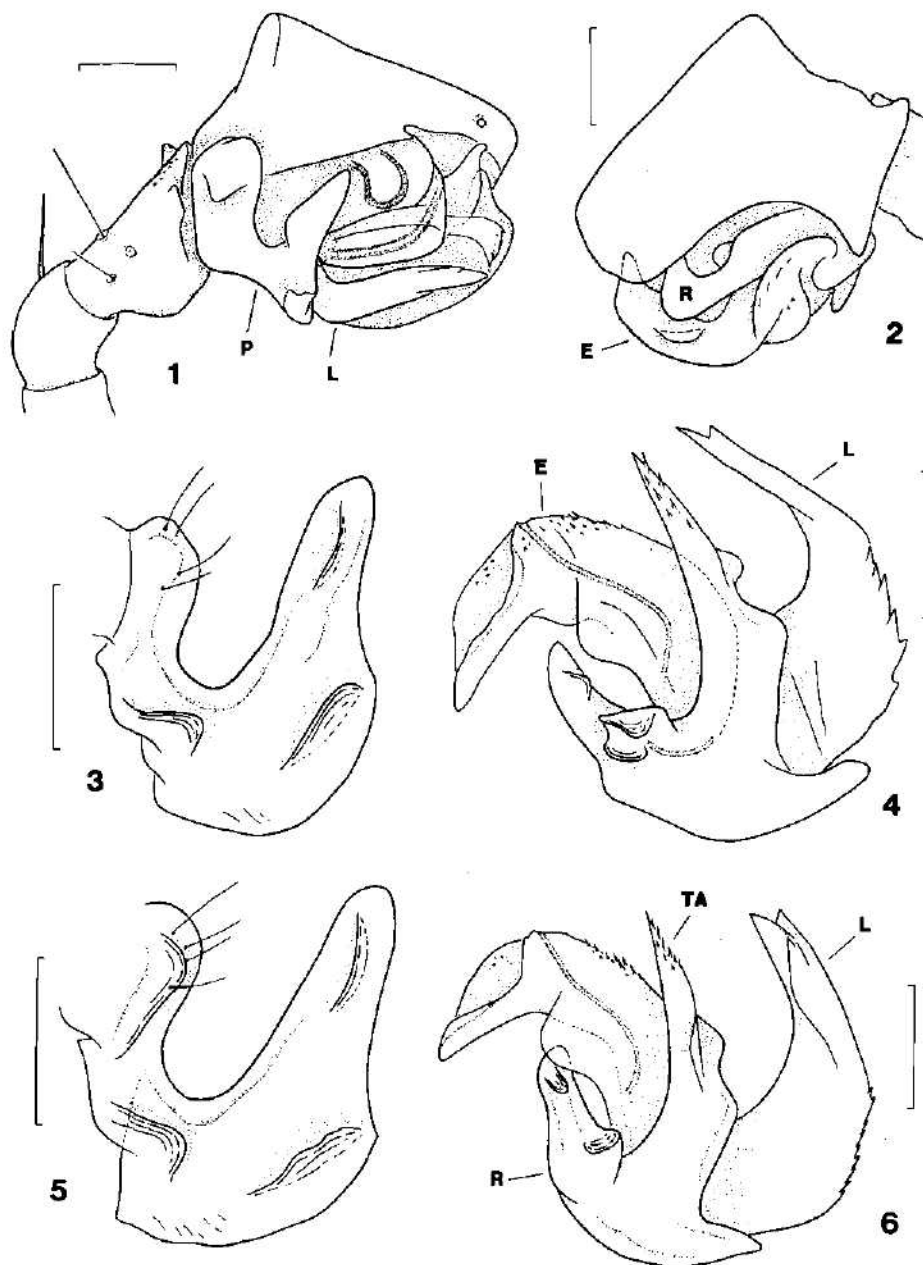
ETYMOLOGY. The species is named in honour of Prof. Dr. František Miller, Brno (1902–1983).

DIAGNOSIS. *M. milleri* sp. n. is characterised by its lamella characteristica (fig. 9, 10) without prominent dorsal bulge and with slender distal half, as compared with *M. rurestris* (C. L. Koch) and *M. resli* Wunderlich. It is considered to be an endemic species of sudeto-carpathian range.

Male: In general characters *M. milleri* sp. n. closely resembles its congeners. Total length 1.7–2.0 (n=7), prosoma length 0.75–0.85 (n=11), femur I ca. 1.1 prosoma length. Chelicerae as in *M. resli* with a dense field of ca 40 stridulatory ridges. Tibiae I–IV with 2 dorsal spines, their length ca 1.8 diameter of tibia. Tm I 0.25. Colour uniform, carapace brown, abdomen blackish, legs yellow. Palpal organ: figs 1, 2; very close to *M. rurestris* and *M. resli* (see Wiehle 1956, Wunderlich 1973). Cymbium, paracymbium (figs 3 vs. 5), terminal apophysis and embolus (figs 4 vs. 6) are almost of the same shape. As in *M. resli* the dorsal tibial apophysis is stronger than the lateral one (figs 7 vs. 8). The main character is provided by the lamella char. This is a strongly bent sclerite as can be seen in dorsal view (fig. 4), so comparisons must take care to view it from the same direction. In *M. milleri* sp. n. the distal half of the lamella is long and slender as compared to its congeners (figs 9, 10 vs. 11, 12); there is no steeply prominent bulge at its dorsal rim as in *M. rurestris* (fig. 12). Populations from the Giant Mts. and from the High Tatra (Figs 9 vs. 10) share the same lamella and are therefore considered to be conspecific.

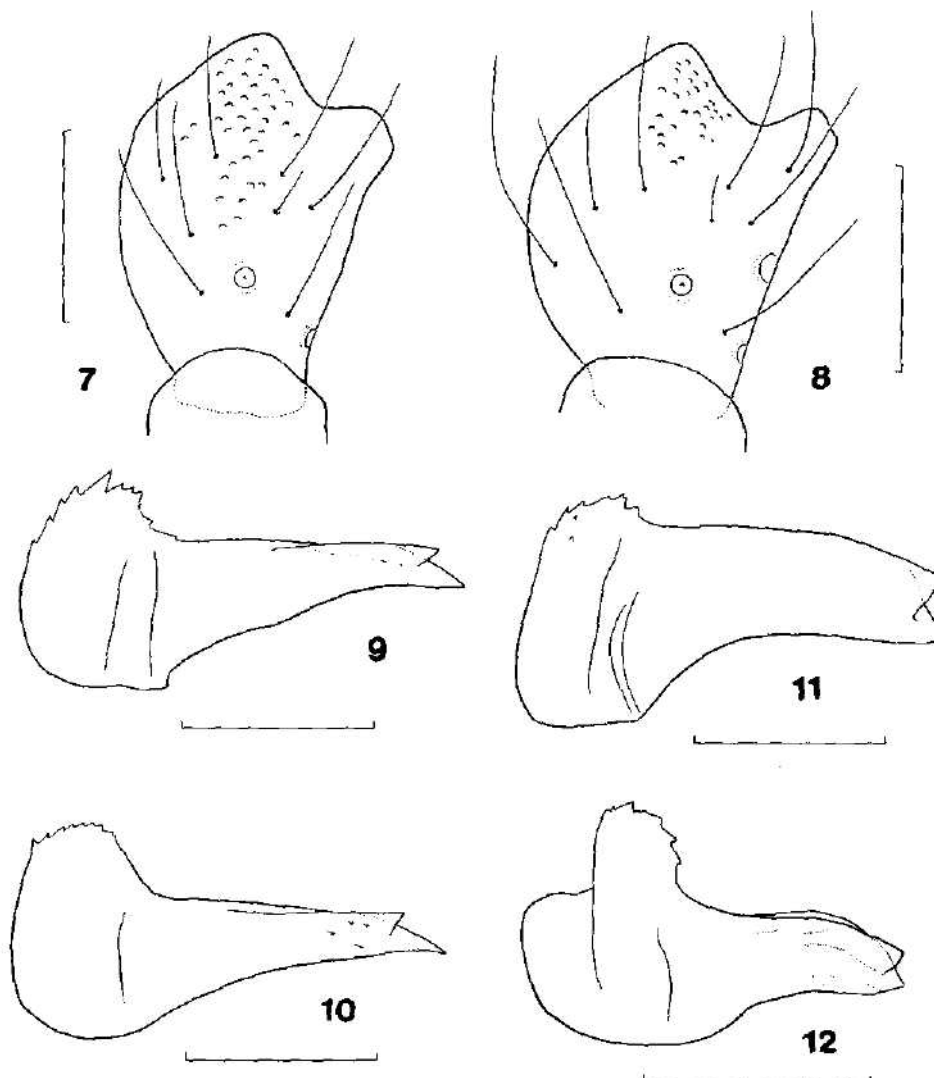
Female: Not known.

AFFINITIES. According to the main textbooks about mid-European Linyphiidae (Locket & Milledge 1953, Wiehle 1956; see also Saaristo 1973), *M. milleri* sp. n. stands close to *M. rurestris*: tibiae I, II without retrolateral spine; cymbium without prolateral process. As has since been recognized (Wunderlich 1973), further cryptic species have been confused in the past with this common aeronaut in the agricultural landscape of mid-Europe. The dorsal rim of the lamella is



Figs 1–6: *Meioneta milleri* sp. n. (1–4, specimen from Pančická louka), *M. ressi* Wunderlich (5–6, specimen from Austria, Carinthia, Glocknerstraße 1900–2500m, leg. Thaler 1989). Male palp, retrolateral view (1) and prolateral view (2). Paracymbium (3, 5). Embolic division, dorsal view (4, 6). – E embolus, L lamella characteristica, P paracymbium, R radix, TA terminal apophysis. Scale lines 0.1 mm.

not bulging in *M. milleri* sp. n. We might infer therefore, that our new species is allied rather to *M. reszli* from the alpine zone of the East Alps (Van Helsdingen 1982, Thaler 1983) than to the lowland species *M. rurestris* or to *M. pseudorurestris* Wunderlich, 1980 from the Mediterranean region (Thaler 1977, Wunderlich 1980). Also the northern species *M. similis* (Kulczynski, 1926) has a similar lamella to *M. milleri* sp. n. (Wunderlich 1973, Palmgren 1975).



Figs. 7-12: *Meioneta milleri* sp. n. (7, 9-10, specimens from Pančická louka (7, 9) and from Roháče (10)), *M. reszli* Wunderlich (8, 11, same locality as in Figs 5-6), *M. rurestris* (C. L. Koch) (12, specimen from Austria, Vienna). Male palpal tibia, from above (7-8). Lamella characteristic (9-12). Scale lines 0.1 mm.

Female not known, probably close to *M. rurestris*. In the samples available the new species occurred syntopically with *M. rurestris*. We were unable to identify the female of *M. milleri* sp. n. with certainty.

DISTRIBUTION, HABITAT. Known only from low mountains of mid-Europe, eastern group (Giant mts., Jizerské Mts.), and from the Carpathian Mts., High Tatra. *M. milleri* has been found there in open sites, in peat bogs and in alpine meadows, from about 1000–2000 m a. s. l. Earlier records of *Meioneta* species from these regions presumably will also include *M. milleri* sp. n.

DISCUSSION

If the supposed relationships of *M. milleri* sp. n. prove correct, this species together with *M. ressl*i from the Alps and *M. similis* might be accepted as a superspecies. *M. similis* was described from Kamchatka and is now known to be boreal trans-palearctic, occurring also in the mountains of South Siberia (Mikhailov 1997) and in Lapland (Holm 1950, Palmgren 1975). Probably *M. levinseni* (Sörensen, 1898) from Greenland also belongs to this complex (Wunderlich 1973). Such an allopatric distribution pattern probably reflects fragmentation of ranges in a mesocratic phase of the glacial cycles and speciation in isolated mountain populations in Europe. *M. ressl*i has been recorded also from Caucasus, the Kopetdagh Mts. and from the Urals (Mikhailov 1997). The identity and affinities of these populations needs to be re-examined more closely, in the light of the existence of *M. milleri* sp. n. in the Sudeten Mts. and in the High Tatra.

Acknowledgements

We are grateful to Josef Rusek (České Budějovice) for kindly supplying the specimens and to Barbara Thaler for help with the illustrations. For linguistic improvement we thank Peter Merrett (Swanage, England).

REFERENCES

- BUCHAR J. 1967: [Spider fauna of Pančická louka and surroundings]. *Opera Corcontica* 4: 79–93 (in Czech, German abstr.).
- DAHL F. 1883: Analytische Bearbeitung der Spinnen Norddeutschlands mit einer anatomisch-biologischen Einleitung. *Schr. Naturwiss. Ver. Schleswig-Holstein* 5: 1–72.
- DAHL F. 1886: Monographie der Erigone-Arten im Thorell'schen Sinne, nebst andern Beiträgen zur Spinnenfauna Schleswig-Holsteins. *Schr. Naturwiss. Ver. Schleswig-Holstein* 6: 65–102.
- HELSDINGEN P. J. VAN 1982: Quelques remarques sur les Linyphiidae mentionnés par Di Caporiacco. *Rev. Arachnol.* 3: 155–180.
- HOLM A. 1950: Studien über die Spinnenfauna des Torneträskgebietes. *Zool. Bidr. (Uppsala)* 29: 103–213.
- KOCH C. L. 1836: *Die Arachniden*. Bd 3. Nürnberg: C. H. Zeh, 120 pp.
- KOCH C. L. 1841: *Die Arachniden*. Bd 8. Nürnberg: C. H. Zeh, 131 pp.
- KÜRKA A. 1994: A survey of spiders in Prof. F. Miller's collection (Department of Zoology, Museum of natural History, National Museum), Part 1. *Čas. Nár. Muz., Ř. Přírodověd.* 163: 43–54.
- KÜRKA A. 1996: A survey of spiders in Prof. F. Miller's collection (Department of Zoology, Museum of natural History, National Museum), Part 2. *Čas. Nár. Muz., Ř. Přírodověd.* 165: 133–138.
- LOCKET G. H. & MILLIDGE A. F. 1953: *British Spiders Vol. 2, No 137*. Ray Soc., 449 pp.
- MIKHAILOV K. G. 1997: Catalogue of the spiders of the territories of the former Soviet Union (Arachnida, Aranei). *Arch. Zool. Mus. Moscow State Univ.* 37: 1–416.
- MILLER F. 1947: [Spiders of the serpentine steppe near Mohelno]. *Mohelno (Brno)* 7: 1–107, tab. 1–16 (in Czech, French abstr.).
- PALMGREN P. 1975: Die Spinnenfauna Finnlands und Ostfennoskandiens 6. Linyphiidae 1. *Fauna Fennica* 28: 1–102.
- PLATNICK N. I. 1993: *Advances in spider taxonomy 1988–1991. With synonymies and transfers 1940–1980*. New York: New York Entomol. Soc. & Amer. Mus. Natur. Hist., 846 pp.
- REIMOSER E. 1919: Katalog der echten Spinnen (Araneae) des paläarktischen Gebietes. *Abh. Zool.-Bot. Ges. Wien* 10(2): 1–280.

- ROEWER C. F. 1928: 4. *Ordnung: Araneae. Echte oder Webespinnen*. *Tierwelt Mitteleuropas* 3 (2): VI. Leipzig: Quelle & Meyer Ver., 144 pp.
- SAARISTO M.I. 1973: Taxonomical analysis of the type-species of Agyneta, Anomalaria, Meioneta, Aporagus, and Syedrula (Araneae, Linyphiidae). *Ann. Zool. Fenn.* 10: 451–466.
- THALER K. 1977: Einige Linyphiidae (sensu lato) aus Tunesien (Arachnida, Aranei). *Rev. Suisse Zool.* 84: 557–564.
- THALER K. 1983: Bemerkenswerte Spinnenfunde in Nordtirol (Österreich) und Nachbarländern: Deckennetzspinnen, Linyphiidae (Arachnida: Aranei). *Veröff. Mus. Ferdinandeum (Innsbruck)* 63: 135–167.
- THALER K. 1989: Epigäische Spinnen und Weberknechte (Arachnida: Aranei, Opiliones) im Bereich des Hohenranseckes Glocknerstrasse – Südschnitt (Kärnten, Österreich). *Veröff. Österr. MaB-Programm* 13: 201–215.
- WIEHLE H. 1956: *Spinnentiere oder Arachnoidea (Araneae)*, 28. Familie Linyphiidae-Baldachinspinnen. *Tierwelt Deutschlands* 44. Jena: Gustav Fischer verlag, 337 pp.
- WUNDERLICH J. 1973: Weitere seltene und bisher unbekannte Arten sowie Anmerkungen zur Taxonomie und Synonymie (Arachnida: Araneae). *Senckenbergiana Biol.* 54: 405–428.
- WUNDERLICH J. 1980: Linyphiidae aus Süd-Europa und Nord-Afrika (Arach.: Araneae). *Verh. Naturwiss. Ver. Hamburg (NF)* 23: 319–337.

INSTRUCTIONS TO AUTHORS

Acta Societatis Zoologicae Bohemicae publishes in English, original papers on general, applied and systematic zoology, biographies and book reviews. Papers by members of the Czech Zoological Society are preferred. It is understood that manuscripts submitted are not offered to any other journal for prior or simultaneous publication.

Authors of taxonomic papers must respect the articles of International Code of Zoological Nomenclature (Third Edition, 1985) and observe its recommendations. The manuscript, including footnotes, references and tables, must be typed with double spacing (30 lines per page) on side A4 paper (210 mm × 297 mm), in duplicate, and should be not longer than 30 pages. Pages must be numbered throughout the manuscript. Final version (corrected as requested referees and editorial board) is preferably accepted on IBM PC – compatible 5.25" or 3.5" diskette.

Heading. Title of paper, full name(s) of author(s), place of work with full address – on separate line.

Abstract summarizing consisely the contents of the paper and indicating the relevance of the work, should not exceed 20 type-written lines.

Key words. Select a set (one or two lines) of key words (index terms).

References. Within the text – Dryden (1968), (Latin 1967), Kummari & Nair (1967), Tamiro et al. (1970), the full citation should be given in the list of references. Under the References authors should be cited in full followed by abbreviations of periodical in accordance with The World List of Scientific Periodicals, 4th edition. London: Butterworths (1964–1965). The number is to be given (in parentheses) only when individual numbers are paginated independently (see example b). References to papers published in languages other than the major ones, or printed in characters other than Latin, should be content English translation, with an appropriate note at the end (see examples e, f, g, h).

Examples:

- (a) Dryden G. L. 1968: Growth and development of *Suncus murinus* on Guam. *J. Mammal.* 49: 51–62.
- (b) Lonberg E. & Gustavson C. 1937: Contribution to the life history of the striped wrasse. *Ark. Zool.* 29(7): 1–16.
- (c) Lattin G. de 1967: *Grundriss der Zoogeographie*. Jena: Fischer Verlag, 602 pp.
- (d) Makin D. 1989: The status of bats in Israel. Pp.: 403–408. In: Hanák V., Horáček I. & Gaisler J. (eds.): *European Bat Research 1987*. Praha: Charles Univ. Press, 718 pp.
- (e) Schornikov E. I. 1969: A new family of Ostracoda from the supralittoral zone of Kuril Islands. *Zool. Zh.* 48: 494–498 (in Russian, Engl. abstr.).
- (f) Nikolajev G. V. 1987: *Plastinčatousye žuki (Coleoptera, Scarabaeoidea) Kazakhstana i Srednej Azii [Scarabaeoidea (Coleoptera) of Kazakhstan and Central Asia]*. Alma-Ata: Izd. Nauka KazSSR, 232 pp. (in Russian).
- (g) Nikolajev G. V. 1987: *Plastinčatousye žuki (Coleoptera, Scarabaeoidea) Kazakhstana i Srednej Azii [Scarabaeoidea (Coleoptera) of Kazakhstan and Central Asia]*. Alma-Ata: Izd. Nauka KazSSR, 232 pp. (in Russian).
- (h) Lekeš V. 1993: [Macrolepidoptera of the Polabí lowland]. *Polabská Příroda* 4: 19–20 (in Czech).

Illustrations and their captions or legends must form a separate unit. Clear technically perfect line drawings and photographs (black-white, glossy) are accepted. The original drawing and photograph (one set) should be more than twice as large as when printed and preferably into blocks or plates so that the blocks of drawings or photographs may be uniformly reproduced over the age with the journal. Legends to the illustrations should be supplied on a separate sheet of paper. References to illustrations and tables in the text: Fig. 1; Figs 1–2; Plate 1, Fig. 1 (for photographic plates); Table 1; Tab. 1; Tabs 1–2.

Tables including headings and explanations should be on separate sheet of paper, numbered consequently with Arabic numerals.

Marking in the manuscript (in light pencil, not in ink or type written). In the text: Latin taxa up to generic level – with wavy underling (italics). In the References: names of periodicals (not the Latin names of taxa) with wavy underling.

Proofs will be sent to authors. One hundred reprints are supplied free of charge. Manuscripts of published papers, diskettes and originals of illustrations are not returned unless return requested.

Address of the editorial office: *Acta Soc. Zool. Bohem.*, Dr David Král, Viničná 7, CZ–128 00 Praha 2, Czech Republic.

CONTENTS

Articles

DOBRORUKA L. J.: Predatory behaviour of four species of jumping spiders of the genus <i>Evarcha</i> (Araneae: Salticidae)	279
HAJER J.: Glandular hairs of spiders of the genus <i>Atypus</i> (Araneae: Mygalomorphae)	287
KLIMEŠ L.: Harvestman (Phalangida) assemblages in the Czech Republic	297
KOVARIK F.: Revision of the genera <i>Lychas</i> and <i>Hemilychas</i> , with descriptions of six new species (Scorpiones: Buthidae)	311
MILLER F.† & BUCHAR J.: Spiders (Chelicerata: Araneae) collected in small mammal nests in the Western Carpathians	373
RŮŽIČKA V. & HEJHAL J.: Succession of epigeic spider communities (Araneae) on spoil banks in North Bohemia	381
THALER K., BUCHAR J. & KŮRKA A.: A new species of Linyphiidae (Araneae) from the sudeto-carpathian range (Czech Republic and Slovakia)	389

Anniversaries

RŮŽIČKA V.: Professor Jan Buchar – a tribute to his 65th birthday (with an Arachnological bibliography of prof. Jan Buchar)	269
BUCHAR J.: In memory of the late Professor Miller on his 95th birthday (with a bibliography)	275

ACTA SOCIETATIS ZOOLOGICAE BOHEMICAE

Vol. 61 – 1997

Editorial Board

Karel Hůrka (Editor in Chief), David Král (Executive Editor), Petr Benda, Jan Buchar, Ivo Hodek, Alois Honěk, Jaroslav Hrbáček, Vojtěch Jarošík, František Moravec, Vladimír Jan Amos Novák†, Josef Rusek, František Sládeček†, Jiří Vávra, Zdeněk Veselovský, Jan Zima

**Czech Zoological Society
Praha**

ACTA SOCIETATIS ZOOLOGICAE BOHEMICAE

Vol. 61 – 1997, No. 1–4

CONTENTS

Articles

BEČVÁR S.: Notes on the genus <i>Ahexaroptrum</i> with a description of new species (Coleoptera: Tenebrionidae: Coelometopinae)	85
BERAN L.: First record of <i>Sinanodonta woodiana</i> (Mollusca: Bivalvia) in the Czech Republic	1
BOČÁKOVÁ M.: Revision of the genus <i>Melaneros</i> from China with a note on <i>Ditoneces</i> (Coleoptera: Lycidae)	175
DOBRORUKA L. J.: Predatory behaviour of four species of jumping spiders of the genus <i>Evarcha</i> (Araneae: Salticidae)	279
FLEGR J. & ZÁBOJ P.: PTPT, the freeware program for permutation testing concordance between phylogeny and the distribution of phenetic traits	91
FRYNTA D., MORAVEC J., ČIHÁKOVÁ J., SÁDLO J., HODKOVÁ Z., KAFTAN M., KODYM P., KRÁL D., PITULE V. & ŠEJNA L.: Results of the Czech Biological Expedition to Iran. Part 1. Notes on the distribution of amphibians and reptiles in Iran	3
HAJER J.: Glandular hairs of spiders of the genus <i>Atypus</i> (Araneae: Mygalomorphae)	287
HÁNEŠ L.: Vertical distribution of soil nematode diversity and abundance in a Central European oak forest	97
HONEK A.: Incidence of protogynous and protandrous development in the pre-imaginal stage of insect development: an overview	113
HOVORKA O.: New <i>Clinidium</i> species from Ecuador (Coleoptera: Carabidae: Rhysodini)	19
HÚRKA K.: New data on taxonomy and distribution of Palaearctic, Oriental and Neotropical Ischnopsyllidae (Siphonaptera), Nycteribiidae and Streblidae (Diptera)	23
HÚRKA K.: The status of <i>Tetraplatypus</i> (Coleoptera: Carabidae: Stenolophina) and larval description of <i>Bradycellus ruficollis</i> and <i>B. verbasci</i>	191
KLIMEŠ L.: Harvestman (Phalangida) assemblages in the Czech Republic	297
KOVAŘÍK F.: <i>Afroisometrus</i> gen. n. from Zimbabwe (Scorpiones: Buthidae)	35
KOVAŘÍK F.: Results of the Czech Biological Expedition to Iran. Part 2. Arachnida: Scorpiones, with descriptions of <i>Iranobuthus krali</i> gen. n. et sp. n. and <i>Hottentotta zagrosensis</i> sp. n. (Buthidae)	39
KOVAŘÍK F.: Revision of the genera <i>Lychas</i> and <i>Hemilychas</i> , with descriptions of six new species (Scorpiones: Buthidae)	311
KRÁL D.: A review of Chinese <i>Aphodius</i> species (Coleoptera: Scarabaeidae). Part 3: description of two new <i>Agolius</i> species with a key to Chinese and Himalayan species of this subgenus	53
KRÁL D.: A review of Chinese <i>Aphodius</i> species. Part 4: subgenera <i>Pseudacrossus</i> and <i>Qingaphodius</i> sbg. n. (Coleoptera: Scarabaeidae)	129
KRÁL D.: A review of Chinese <i>Aphodius</i> species (Coleoptera: Scarabaeidae). Part 5: subgenus <i>Aphodius</i>	199
MACHOLÁN M. & VOHRALÍK V.: Note on the distribution of <i>Mus spicilegus</i> (Mammalia: Rodentia) in the south-western Balkans	219

MILLER F.† & BUCHAR J.: Spiders (Chelicerata: Araneae) collected in small mammal nests in the Western Carpathians	373
MLIKOVSKÝ J.: Sternal pneumatization in the waterfowl (Aves: Anatidae)	227
MLIKOVSKÝ J., CHENZHYCHENOVA F. & FILIPPOV A.: Quaternary birds of the Baikal region, East Siberia	151
MORAVEC F., GELNAR M., ERGENS R. & SCHOLZ T.: Metazoan parasites of fishes from the section of the Vltava River supposed to be affected by the operation of the Temelín nuclear electric power-station, Czech Republic	65
PAPÁČEK M., SOLDÁN T. & TRUHLÁŘOVÁ I.: Development of the female internal reproductive system in <i>Ilyocoris cimicoides</i> (Heteroptera: Nepomorpha: Naucoridae)	77
RAKOVÍČ M.: A review of the genus <i>Odochilus</i> (Coleoptera: Aphodiidae: Odochilinae)	157
RAKOVÍČ M. & KRÁL D.: New taxa, new combinations and current taxonomic status of tribes and genera of Psammodiinae (Coleoptera: Scarabaeoidea: Aphodiidae)	223
RŮŽIČKA V. & HEJKAL J.: Succession of epigeic spider communities (Araneae) on spoil banks in North Bohemia	381
SEICHERT V. & RYCHTER Z.: Topogenesis of visceral organs related to the longitudinal growth of the embryonal axis	169
THALER K., BUCHAR J. & KŮRKA A.: A new species of Linyphiidae (Araneae) from the sudeto-carpathian range (Czech Republic and Slovakia)	389
VOLKOVITSH M. G. & BÍLÝ S.: A new species of <i>Chalcogenia</i> from Israel, and notes on the systematic position of the genus (Coleoptera: Buprestidae: Anthaxiini)	249
Obituary	
NEDVÍDEK J. & ROMANOVSKÝ A.: In memoriam Professor František Sládeček	265
Anniversaries	
RŮŽIČKA V.: Professor Jan Buchar – a tribute to his 65th birthday (with an Arachnological bibliography of prof. Jan Buchar)	269
BUCHAR J.: In memory of the late Professor Miller on his 95th birthday (with a bibliography)	275
Book reviews	
Kühnel W.: Taschenatlas der Zytologie, Histologie und mikroskopischen Anatomie für Studium und Praxis. Eight rewritten and expanded edition – by J. Jíra	18
Röllinghoff M. & Rommel M. (eds.): Immunologische und molekulare Parasitologie. – by J. Jíra	34
Hartwich G.: II. Strongylida.: Strongyloidea und Ancylostomatoidea. Die Tierwelt Deutschlands. 68. Teil. – by J. Jíra	38
Mullis K. B., Ferré F. & Gibbs R. (eds.): The Polymerase Chain Reaction – by J. Jíra	96
Hausmann K. & Hülsmann N. (eds.): Progress in Protozoology. Proceedings of the IX International Congress of Protozoology. Berlin 25–31 July 1993 – by J. Jíra	150
Ripert C. (coordonnateur): Épidémiologie des maladies parasitaires. Tome 1. Protozooses – by J. Jíra	198
Schmid G. H., Radunz A. & Gröschel-Stewart U.: Immunologie und ihre Anwendung in der Biologie – by J. Jíra	168

Data of appearance of the issues

- 1 – April 1, 1997
- 2 – June 30, 1997
- 3 – October 17, 1997
- 4 – December 29, 1997